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New-York Tribune.

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LECTURES AND LETTERS.

NATIONAL ACADEMY OF SCIENCES.

(*Meeting at Washington, April*, 1874.)

AMERICAN ORIENTAL SOCIETY.

(*Meeting at Boston, May*, 1874.)

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New-York Tribune.

FOUNDED BY HORACE GREELEY.

NEW-YORK, MAY, 1874.

LECTURES AND LETTERS.

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THE ACADEMY OF SCIENCES.

SESSION AT WASHINGTON—FIRST DAY.

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[FROM THE SPECIAL CORRESPONDENT OF THE TRIBUNE.]

WASHINGTON, April 21.—The National Academy of Sciences is obliged by the terms of its charter from Congress to hold a meeting in April of each year at Washington. It usually happens that the accumulation of papers which the members are anxious to put on record is too great to wait for the annual opportunity, and that a meeting is called some time during the Fall to throw off the superfluous load. This was the case last year, and led to the meeting in New-York in October, which was fully reported at that time in THE TRIBUNE. But the Washington meeting is always regarded as the one of greater consequence; and as the National Academy is the highest scientific body in the country, this session must be considered as of the utmost importance. To it the most eminent men in their special pursuits whom America possesses, contribute the fruit of their painstaking researches, not unfrequently embodying in a single paper the labors, not to say the aspirations, of months or even years.

The meeting was held at the Smithsonian Institution, a temple of science which is the fitting repository where from all lands and seas curious and valuable things have been collected, till now it takes high rank among the few great museums of the world. The venerable Prof. Henry, Secretary of the Institution, presided over the deliberations of the Academy. The limited number who by the system of election can be joined to our "immortals" were more largely in attendance than last year at Columbia College. There was a sprinkling of curious visitors, but the Academy makes no bid for popularity.

Prof. Le Conte was called upon for the opening paper, which was a delicate compliment to a rival institution, as he is the President elect of the American Association for the Advancement of Science, a body which has a larger hold on the popular heart than the Academy.

CLASSIFICATION OF THE RHYNCHOPHOROUS COLEOPTERA.

BY JOHN L. LE CONTE, M. D.

Dr. Le Conte's paper began with an allusion to the fact that at the January meeting of the Academy of Sciences in 1867 he had opened the subject now under consideration. The group of insects referred to are exceedingly complex in their characteristics, and good European entomologists had made frequent efforts to settle their classification. These attempts were reviewed historically, and the methods and systems were detailed of Schonherr in 1833-34 and Prof. Lacordaire in 1863, the latter being somewhat supplementary; of Mr. H. Jekel in 1860; the remarks of Mr. Suffrain in 1847, and of the work of Prof. C. G. Thompson in 1865, and the careful studies of Dr. George H. Horn, 1873. From the last-named work Dr. Le Conte selects a statement concerning the males of some genera having eight and the females seven dorsal abdominal segments, and calls attention to the importance and wide extent of this characteristic. He has made a series of dissections of Rhynchophorous insects, and makes a division of them into three series: (1.) Haplogastra, having abdomen alike in both sexes; ventral segments not prolonged upward into a sharp edge. (2.) Allogastra, abdomen dissimilar in the two sexes; ventral segments prolonged upward, forming a sharp edge. (3.) Heterogastra, abdomen alike in both sexes; ventral segments prolonged upward to fit into the elytral groove. Many other distinctive characteristics were given, with a detailed description of the very numerous genera belonging to each of the series.

Although principally devoted to classification, Prof. Le Conte's paper gave many points respecting the habits of some of those destructive insects. The Attelabidæ and some Rynchitidæ provide for their progeny in the Spring. The females roll up the leaves of trees and deposit in each roll an egg, the inside of the leaf furnishing food to the larva when hatched. Other Rinchites deposit their eggs in young fruit, the kernel of which is eaten by the larvæ; others in undeveloped buds of trees, which are thus destroyed. A European species of the Rhinomaceridæ deposits eggs in the male flowers of the *Pinus maritimus*, the development of which is thus prevented. The results of years of laborious dissections and study seem to have been compressed in this paper of Dr. Le Conte, and the exact anatomy and characteristics of a vast number of insects, many of them the pests of the husbandman or fruit-raiser, were given at great length; but the paper was far too technical for the average reader.

AN AUTOMATON TO PLAY TIT-TAT-TOO.

BY PROF. FAIRMAN ROGERS OF PHILADELPHIA.

This paper described combinations of mechanism for imitating mental processes, illustrated by means of diagrams showing the peculiar requirements of an automaton which should play the game of tit-tat-too against an opponent; the play of the automaton to be a resultant effect of the play of his opponent.

Among the various classes into which machines may be divided, we find those which have for their object the mere transformation of motion according to various sequences, as is the case in clocks, certain portions of moving machinery, and especially calculating machines. In all these the apparatus being constructed according to a certain law, goes through operations automatically, which resemble to a greater or less extent the operations of the human mind. In the case of the calculating machine it reproduces and extends in a regular sequence the form with which it starts.

Babbage, in speaking of his analytical engine, has suggested that a machine might be made which would play a game of combination such as draughts, provided the maker of the machine himself could work out perfectly the sequences of the game. He does not appear to have published anything further on this subject, except to suggest that the child's game of tit-tat-too is the simplest of all the games of combination, and therefore possible to be played by an automaton.

The author of this paper finds that the sequences of this game being readily tabulated, it is possible to arrange a machine which will follow them, and which will have the power of apparently selecting the course which will lead to success when there are two ways open to it. It differs from the calculating

machine in so far that it not only follows out a regular sequence as the result of its construction, but it is able to follow out the principle of the game when modified by the varying and unexpected moves of its antagonist. The manner in which this is done is briefly as follows: The opponent to the automaton makes the first move in the game, and in so doing causes a certain cylinder or equivalent device to change its position. This, from the construction of the apparatus, causes the automaton to make that play which the proper sequence of the game requires, and at the same time moves the corresponding cylinder into position. The next play of the opponent moves the third cylinder, and the combination of the three cylinders determines the action of the automaton for the fourth; and so on throughout the sequence. If the player plays perfectly, the game will be drawn, as the automaton's play is mathematically correct. If the opponent makes a mistake, the automaton, by a simple device, takes advantage of it, and makes such a play as to win the game. Illustrations were then given on the blackboard, showing that there were three general conditions of the problem, the third being much more complicated than the other two.

The application of this mechanism to a game of this kind is intended to illustrate its character, and to show that its addition to apparatus for registering physical phenomena, or for performing geometrical or mathematical operations, may enable such mechanical devices to have a use much more extended than heretofore.

The paper of Prof. Rogers excited much interest, and the practicable character of the proposed automaton was very clearly demonstrated. Prof. Hilgard inquired how many pieces of machinery were necessary. Mr. Rogers said that in the first of the three cases involved by the problem, there were 18 levers required; in the second case, 32; in the third, 48. As many cylinders were required as there are units in the game; as many levers as there are combinations. To economize machinery, the board itself turned round a half or more.

Prof. Hilgard asked whether we do not really think very much as the automaton acts—whether the mental process was not similar to the mechanical. Prof. Henry said that the question was transcendental in its character. Mr. Rogers mentioned that several solitaire games could be played by an automaton, and that the machinery for this was very simple, but it had not the same interest as a machine which could take advantage of an opponent's mistakes.

Three papers by Prof. A. M. Mayer of the Stevens Institute of Technology, Hoboken, in the absence of their author, were read by the Secretary of the Academy.

FUNCTIONS AND MECHANISM OF AUDITION.

BY PROF. A. M. MAYER.

This paper was entitled Suggestions as to the Functions of the Spiral Scalæ of the Cochlea, leading to an Hypothesis of the Mechanism of Audition. It opened by a reference to the paucity of investigations on the form and functions of the cochlea, and mentioned as the principal if not the only contribution to the subject the statements and suggestions of Dr. J. W. Draper in his work on physiology in 1853. Prof. Mayer dissents, however, from the view taken by Dr. Draper respecting the action of the auditory apparatus, basing his objections on a measurement of the wave-lengths of the assumed vibrations and a comparison of those lengths with the lengths of the spiral scalæ which were believed by Dr. Draper to be the subjects of these vibrations. Prof. Mayer shows that the scalæ are too short to fulfill the requirement.

Prof. Mayer's paper then gives a careful, detailed, technical review of the anatomy of the ear. He then undertakes to show that the significance of these anatomical relations is to bring the sound vibrations to act with the greatest advantage on the co-vibrating parts of the ear, and to cause these parts to make one-half as many vibrations in a given time as the tympanic or basilar membranes. This is demonstrated by an extended review of the functions and possibilities of different portions of the auditory apparatus. In the course of this train of argument Prof. Mayer advances the view that what are known as the hair-cell cords, having swellings in the middle of their lengths which cause them to act like loaded strings, are probably so constituted that each hair-cell cord is adapted to co-vibrate with only one special sound. He mentions, referring to one of his own discoveries reported in THE TRIBUNE last October, that these hair-cell cords are placed in reference to the pulses striking them, somewhat in the relation which the external fibrils of the musketo bear to a wave-surface to which their lengths are perpendicular. If his view be correct, these cords bear to the membrane to which they are attached, the same relation as stretched strings bear to the vibrating tuning-forks in Melde's experiments, and therefore a cord in the ductus of the ear will vibrate only half as often in a second as the basilar membrane to which it is fastened.

Prof. Mayer was able to illustrate this theory by an apparatus devised for the purpose. But perhaps the most convincing experiment in support of the hypothesis was this: a tuning fork held near the ear causes a sensation corresponding to the designated pitch of the fork. But the vibrations of this fork can be sent to the inner ear through the bones of the head. Now if we first hold the fork near to the ear and note its pitch, and then press it firmly against the temporal bone, we perceive a marked difference; we hear the simple sound of the fork accompanied by its octave. By a variety of modifications this effect was clearly brought out, the sound communicated only to the internal ear always having the higher octave of the fork singing along with its usual note. If the external ear be now closed, the higher octave sounds as loud as the original note. Prof. Mayer has the testimony of an accomplished musician to the success of this remarkable experiment.

DURATION OF THE SENSATION OF SOUND.

BY PROF. A. M. MAYER.

This paper was headed Abstract of a Research in the determination of the Law connecting the pitch of a sound with the duration of its residual sensation, and on the determination of the numbers of beats —throughout the range of musical sounds—which produce the most dissonant sensations; with applications of these laws to the fundamental facts of musical harmony, and to various phenomena in the physiology of audition. Prof. Mayer gave the particulars of a series of experiements by which it was ascertained what must be the frequency of successive sounds to have them blend indistinguishably together. Worked out mathematically, the data indicated that the residual sensation only occupied one five-hundredth of a second in the case of 40,000 vibrations per second; but in the case of 40

vibrations to a second the residual vibration was one-eleventh of a second. He concludes that the whole ear vibrates as one mass, and the durations of these oscillations of the whole ear are far too short to remain one-thirtieth of a second. He thinks that this explains our inability to distinguish the actual pitch of sound when that pitch exceeds certain well-known limits. One of the most remarkable deductions was that the duration of the sensation depends upon pitch rather than upon intensity. A considerable difference in intensity has very little effect upon the duration.

Among the inferences which he draws from this investigation is that the timbre of a composite sound begins to change at the instant the vibrations causing it cease, and the residual sensation becomes more and more simple till at last only the simple sound of the fundamental harmonic remains in the ear. There are analogous phenomena in respect to the sensation of light to the eyes. Another deduction is that a composite sound can be analyzed by means of a revolving disc with sectors cut out of it, interposed before the ear. Already this line of research has cleared up many obscure points in the theory of audition, and it bids fair to correct many grave errors into which previous investigators have fallen.

REFLECTION OF SOUND FROM FLAMES AND HEATED GASES.

BY PROF. A. M. MAYER.

This was a series of experiments showing that flames, heated gases, and cold gases of densities differing from that of the atmosphere, can reflect sonorous aerial vibrations, and the experiments have also given a measure of the reflecting power of flat gas flame. Prof. Mayer was incited to this investigation by reading the exceedingly interesting experiments of Prof. Tyndall on the stoppage of sound in a non-homogeneous atmosphere, and the description of an apparatus devised by Mr. Cottrell to illustrate this, and also a paper by that gentleman on "The Division of a Sound Wave by a layer of Flame or heated gas into a reflected and transmitted Wave."

Prof. Mayer's method of illustration is simple and easy of performance. He takes two similar resonators and places the planes of their mouths at right angles to each other. Then in this angle he firmly fixes the tuning-fork corresponding to the resonators, so that the broad face of one of its prongs faces the mouth of one resonator, while the space between the prongs faces the mouth of the other. Complete interference of the sounds issuing from their mouths is obtained, and the only sound that reaches the ear is the faint sound given by the fork's action on the air outside the angle included by the mouths of the resonators. If in these circumstances we close the mouth of either one of the resonators with a piece of cardboard, the open resonator will strongly reënforce the sound of the forks. If we now cover the mouth of this resonator with card-board, we shall again have silence.

Now substitute for card-board, when both resonators are open, the flame of a bat's wing gas-burner, with one resonator, and use something more permeable to sound than the card-board with the other. By trying a series of more and more permeable diaphragms, it was found that tracing paper just equaled the effect of the gas-flame in guarding the mouth of the resonator from the entrance of sound. A sheet of heated air above the gas-burner was found to be exactly equivalent to the gas-flame. The passage of a sheet of cold coal gas over the mouth of the resonator produced a similar effect; and so also did carbonic acid gas, though in less degree; but cold, dry hydrogen closed the mouth of the resonator more effectively than either of the above gases, though not equal in this respect to the heated air above the bat's wing flame. Among other curious results, Prof. Mayer has ascertained that there is an absorption of sound in the bat's wing flame; that the flame is heated by the sonorous vibrations which enter it as such, and issue as heat vibrations. He has endeavored to obtain a quantitative mathematical analysis of this absorption and hopes for exact results.

TESTS OF THE STRENGTH OF PINE.

BY PROF. W. A. NORTON OF YALE COLLEGE.

This paper was exceedingly elaborate, and gave the results of a series of experiments on the sets or residual deflections of pine sticks after having been subjected to a transverse stress. In 1869 Prof. Norton demonstrated that the received theoretical formula for the deflection of rectangular beams under stress required the addition of another term, varying directly as the length and inversely as the breadth and depth of the beam. Since then he has been more recently experimenting upon residual sets or deflections. The apparatus for testing was described at length and with great detail. Great care was taken to guard against incidental errors, especially in respect to consequences of changing temperature during the stress. There was evidence that after repeated strains a molecular change took place in the wood, and the effect of strain, after an interval of rest, to a great extent not only passed away, but even left the stick with less set than it had a short time before. A great number of curious and seemingly contradictory results were obtained in the course of these very numerous and varied experiments. As one of the results obtained it appears that a load equal to one-fourth of the breaking weight produces a permanent set, and that repeated applications of this load from day to day are attended with a continually increasing set. It results that such wood should never be subjected in any structure to one-fourth of its breaking strain.

Prof. Hilgard suggested that it was desirable to use material for these experiments that could be examined optically, such for instance as glass. He also suggested the extreme similarity of Prof. Thurston's experiments upon the torsion of pine sticks. Prof. Norton was not inclined wholly to accept Prof. Thurston's method of explaining the phenomena. Prof. Hilgard mentioned that glass rods took a set under torsion; Prof. Henry urged the use of homogeneous material in these experiments, and Prof. Rogers suggested brass as a suitable substance; he agreed with Prof. Hilgard in regarding the pine stick as a mere collection of fibers with more or less rosin between them.

The proceedings of the day were closed with the reading of a biographical sketch of Prof. Henry James Clarke.

THREE NOTABLE ESSAYS—SECOND DAY.

DR. BROWN-SEQUARD'S THEORY OF THE OPERATION OF THE NERVES AND BRAIN—PROF. NEWCOMB TELLS OF WHAT AMERICA IS DOING FOR THE COMING TRANSIT OF VENUS—MAJOR POWELL'S EXPLORATION OF THE CAÑONS OF COLORADO.

WASHINGTON, April 22.—Tho session of this day far exceeded its predecessor in interest. It is rather unfortunate that the Academy makes no announcement in advance of the programme for the day, but this is of a piece with its general indifference to public attention. Not only is no programme published, but scarcely any is arranged in advance. Only a few of its members knew that Dr. Brown-Séquard was to deliver an address; still fewer knew that Prof. Newcomb was to speak, and there was an element of uncertainty even as to Major Powell. Had it been generally known that Dr. Brown-Séquard would tell us something about our brains, there would have been no difficulty in packing the long hall of the Smithsonian with an eager audience. A master of a subject with which few are acquainted, he brings to every utterance upon it the rare results of his own inquiries coupled with a freedom from prejudice in favor of antiquated views that is rare in his profession. In this address he gave a clearer expression than ever before to his own views of the structure and functions of the brain and nervous system. Hitherto his lectures seem to have been too much confined to tearing down the edifices of theory which his predecessors have so laboriously reared. The present address is not open to that objection, though it does good service in exposing the fallacy of views recently advanced by Dr. Ferrier of England, formed on a narrow circle of experiments, which have threatened to lead us back into the mists of error from which we were gradually emerging.

The address of Prof. Simon Newcomb, the eminent astronomer of the Washington Observatory, has an immediate interest. Very recently *The London Times*, in a very long article describing the preparations making for observations on the transit of Venus, dismissed those of America in a sentence of almost contemptuous brevity, to the effect that little or nothing was known about them. It is a fact that our preparations are of the most thorough character, that they embrace novel and ingenious modes of procedure, that they are worthy both in their scale and character of the nation and of American science, and that they bid fair to accomplish excellent results. It was to tell of this that Prof. Newcomb emerged from the seclusion of his watch-tower in the skies—a man of bashful and retiring manner, plain and thoughtful in his words, and giving his facts with simple directness of expression. Both Prof. Newcomb and Dr. Brown-Séquard speak without notes, and do not prepare their communications in manuscript.

Major Powell's description of the Cañons of Colorado brings freshly before us the wild features of that strange Western country which he has done so much to explore. His expedition seems to have penetrated regions hitherto deemed almost inaccessible, and he has brought back a large amount of information of value from a scientific point of view, as well as an exceedingly entertaining narrative of adventure.

Notwithstanding the fact that so few knew what was in store for them, there was a considerable popular audience present at the session, including a number of ladies.

FUNCTIONS OF THE BRAIN AND NERVES.

BY DR. C. E. BROWN-SEQUARD.

The title of this address was "On the Pretended Localization of the Mental and the Sensorial Functions of the Brain." Dr. Brown-Séquard began by saying that the subject has been rendered more difficult by assumptions of physiologists upon insufficient data. Among the views which have been recently put forward upon the localization of nervous power in certain parts of the brain, there are two of importance: One relates to the seat of power actuating muscles, and the other is as to the seat of sensation for different nerves. In the latter particular, I shall review especially the assumption in respect to the seat of power for speech. The following are some of the old views respecting the localization in the brain of the various faculties. There was a theory put forward by Müller of Berlin which for a time had great popularity. It was, however, absolutely wrong. It assumed that as regards the power of the action of the will on the muscles, the brain must be considered as the keys of a piano. When the soul or the will acted to produce a movement, it was supposed to act upon the nerves as the fingers upon the keys of a piano. As regards sensation, the mechanism was supposed to be equally simple; it was supposed that there were elements by which the sensations were transmitted through the whole system, without any break, through the spinal cord to the brain.

DEFECTS OF THE MECHANICAL THEORY OF THE NERVES.

This theory assumed that sensation was conveyed through the body by the nerves, as the bells rung in any part of a hotel have the sound conveyed along wires to a central office, where the fact is recognized from where the call may come. But this assumption was just as false as it was simple. There is no such compact continuity. Pathology shows that there is no foundation for such views. In the first place, the spinal cord (which is the organ through which all the nerve fibers or conductors coming through the brain have to pass, and also all the conductors coming from the periphery to the brain have to pass) can be destroyed in great part without destroying either the power of motion or the power of receiving sensations. There are facts respecting the *medulla oblongata*, which as you know is between the brain and the spinal cord, which place this beyond the reach of question, and prevent Müller's theory of mechanism from having our permanent acceptance.

There are other facts relating to this question which are certainly quite clear. There are animals utterly without brain, which still exercise the functions that are supposed to be located in that organ, such for instance as the *Amphioxus lanceolatus*. In others we find the part that answers to the brain is hardly large enough to meet the requirements of such an organ. Now if you hold your arm upon a table and try to make dots with a pencil in your

fingers without changing the position of your arm, you will be able to make perhaps 1,000 points. Well, if such a power as that exists—and, indeed, the number which I have given is not too large, as I have counted 792 points made by myself, and I am a miserable draughtsman—if such a power exists with so little movement, you can easily understand what an immense number of fibers it would require to establish communication between the brain and the periphery, were all the fibers continuous from the brain to the periphery, or vice versa. Again, if we divide a portion of the spinal cord we may find a diminution of sensation and voluntary movement, or both, below the point of division; but the communication is not utterly severed; there is not always complete paralysis, as there should be to satisfy the conditions of the bell-wire theory.

In fact there is no necessity of more than a very few fibers to establish communication between the brain and the spinal cord. It is more like a telegraphic communication than a movement along a wire, by which sensation is conveyed from the periphery to the brain, or the brain transmits its orders to the periphery. Let me give an instance of what I mean. If a piece of ice is laid upon my foot, I have at once, the sensation of a contact, sensation of a temperature, the sensation of the extent of the surface of the ice that touches me, the sensation of the weight of the ice, and, if it is left upon my foot, the sensation of pain, and the sensation of the skin to which the ice is applied. All those forms of knowledge are communicated at once. I believe that all these impressions are communicated to the spinal cord, which as a single wire transmits it to the brain.

PERTINACIOUS ADHESION TO EXPLODED THEORIES.

Now, as to the two sides of the brain, the old view was that the left side of the brain governs the movements of the right side of the body, and the right side governs the movements of the left side of the body; and that there is a similar arrangement respecting perception and sensation. Facts oppose this view. I am sorry to say that physicians adhere too pertinaciously to old views like this, without regarding more recent discoveries. We are constantly holding on to our old clothing, wearing it when it is worn out. I am sorry to speak thus severely of a profession which is my own, but the discoveries of the last ten years seem scarcely to be recognized by the medical faculty. Younger members of the profession should seize opportunities to make themselves familiar with the advances of modern discovery. Take such facts as this for instance: One-third of one-half the brain may be utterly destroyed without any symptom of the injury; then one-third of the other half, and still no symptom. Still another third of either half may be destroyed without any indication of ill-health. There are hundreds of the first-named cases; I know of eleven or twelve of the latter. But Abercrombie and Spicer relate still more remarkable cases. A lady of refinement had had very slight symptoms of any trouble with the brain. She had gone to a tea party and enjoyed herself there; had walked about and talked as if in her usual health. Nothing in her sensations indicated any serious trouble. She was found dead in her bed the next morning. The autopsy revealed that one half of her brain was entirely destroyed, and moreover that this destruction had been of long standing. The account of this is to be found in Abercrombie, page 177, 4th edition.

Let us now consider the question of the locality of the intelligence of the brain. Most physiologists are agreed that this is the gray matter of the upper parts of the brain. But the method of communication is still open to research. Here the lecturer went to the blackboard and drew a figure somewhat like a sheaf of wheat without a band around it; the stalks representing the nerves, the heads of wheat representing the cells. Now you may subtract from this, by disease or otherwise, say the upper third, and still you have the nerves and the nerve cells and the processes can be carried on; but in the progress of such destruction downward there would eventually be reached a point where the functions of the brain could no longer exist. This view would explain the facts as we find them. But there is no case on record where the gray matter on both sides of the brain has been destroyed without the loss of intelligence, and we must regard that gray matter as the seat of the intelligence. But vast portions may be removed before the loss of intelligence becomes apparent. This I have myself tested and proved by vivisection of the lower animals.

Now, in respect to the locality of the power of speech. It has been said that the loss of brain power to express ideas in speech was located in a certain part of the brain. This affection is called aphonia or aphasia. There are three modes of expressing ideas—by speech, by gestures, and by writing. It is with the first only that we are concerned. Some very bold theorists have tried to locate all these powers in a particular part of the brain. Let us confine ourselves to facts. Dr. Broca of Paris has advanced the view that a certain small portion of some of the convolutions of the brain held the power of speech. I admit that facts seemed to favor this view. But we find that there is no relation between the degree of aphasia and the extent of the disease in that part, and there are cases where the destruction of those convolutions is very great and the injury to speech very little. Secondly, we find that disease may have overtaken the anterior, the posterior and the middle lobes of the brain, the particular convolution supposed to involve speech not being affected, and yet there is marked aphasia. Now is some one of these lobes the locality of the power of speech? Such would be the reasoning of my opponents. We should be obliged to concede that in some persons the faculty of speech existed in one part of the brain; in some in another; in others another, and so on *ad infinitum*. This is a *reductio ad absurdum*.

There is the case of the paralysis of the insane, where the gray matter may be diseased on both sides of the brain. In these cases the power of speech does not seem to be involved. There are cases of aphasia where the diseased person has had the power of speech restored during delirium. The speech is coherent, though the sense may not be. It is evident then that the faculty of speech is not actually lost in such cases; and yet we find that the third frontal convolution is actually diseased in these aphasiacs who talk in their delirium. But the most decisive argument is found in the cases that I have seen, where the third frontal convolution, the alleged organ of speech, has been destroyed, and yet the patients have not lost the power of speech. Therefore the theory is itself destroyed. There are fifty cases on record to show that the question of right-handedness or left-handedness does not apply in these considerations. The lecturer here cited cases in the practice of Jaemet of Montpelier and Mr. Prescott-Hewitt of London. In the latter case the patient had suffered a destruction of that part of the brain for 20 years, and yet for 20 years had spoken.

THE LOCALIZATION OF CENTERS OF MOTION IN THE BRAIN.

We shall now take up the question of the localization of motion in certain parts of the brain. I am surprised at the avidity with which a certain series of facts have been accepted as proof of this theory in England. A very eminent man, of whom I should not like to say anything severe, my friend Prof. Carpenter, has accepted those views. I may say that all England has accepted them. Prof. Huxley indeed has written me that he only accepted this view in part; but I cannot see how he can accept a part without accepting the whole, where even the part is incorrect. The famous experiments of Dr. Ferrier of Guy's Hospital must here be considered. As you will see, they are not, however, conclusive. By the application of galvanism to certain parts of the brain of animals, he produced certain movements. When we do not stop to think, this would seem to prove that there are in the brain certain centers of movement governing certain parts. But it is only a semblance. A part of the facts are taken for the whole. We should know all the series before we adopt the conclusions. Let us examine the other facts.

It is perfectly well known that the cutting away of a large portion of the brain does not produce the least alteration of voluntary movement anywhere. Suppose that part of the brain—say the anterior lobe, being excited by galvanism, produces a movement in the anterior limb. Now suppose that part of the brain is cut away—then the anterior limb should be paralyzed, for its voluntary movement is gone. Admitting that the other half of the brain should supply the place of the missing part; let us take that away also. Then certainly there should be a paralysis of the anterior limbs. But there is not. This should be sufficient to invalidate the conclusions of Dr. Ferrier. But there are abundant pathological facts of this nature, proving the fact beyond question. And then there are the cases of recovery from paralysis. There is no such localization of power as Dr. Ferrier has assumed. If galvanism be applied to the severed leg of the frog, the leg will jump, though there is no brain power in the question.

What should have been done was to have cut the connection of parts, so that a general effect should not have been propagated throughtout the brain by the application of galvanism to a part. This would be the *experimentum crucis.* My friend Dr. Dupré of Paris has made this experiment. I made it also, before he did, but he published his before mine. But there are many other facts almost equally impressive in their character which may be cited. We find many cases where the lesion of part of the brain produces paralysis on the same side of the body, and not on the opposite side as in the majority of cases is the rule. There is a case where a ball passed directly through the brain and it produced paralysis on the right side instead of the opposite side. Here Dr. Brown-Séquard objected to having a certain class of brain affections named after him; stating that diseases should be named from their distinctive features and not after physicians.

Dr. Brown-Séquard then applied a similar course of reasoning to the localization of sensation in specific parts of the brain, using, among other happy illustrations, this fact: An intestinal worm will occasion sometimes convulsive movements, sometimes paralysis, sometimes deficient sensation; are we therefore to conclude that in these cases the center of power was in the abdomen? He attacked the view of Gall, saying that we do not know the locality of these affections, and have no reason to suppose that they originate in a limited area of the brain. We now know that only a few fibers are necessary to make the connection between the spinal column and the brain. The brain, like the rest of the body, receives nerve fibers coming from other nervous centers, some along the blood-vessels, for there are a great number of fibers starting along the blood vessels and going into the cellular tissue of the brain; some fibers coming from the sympathetic nerve; others coming from various sources. We find, for instance, that the prick of an exceedingly fine needle at the *crux cerebelli* will produce rotary movements, the animal whirling around with a rapidity impossible in a normal condition. The activity of the heart may be stopped by the prick of a needle point; convulsions may be similarly stopped by the action of carbonic acid on the mucous membrane of the throat. With these facts under consideration we may see the vast field of research that yet lies before us, the mere questions arising from the activity of nerve cells affording an almost boundless subject for inquiry. But it is evident that we cannot locate the centers of either sensation or motion in specific parts of the nervous system.

OBSERVING THE TRANSIT OF VENUS.

BY PROF. SIMON NEWCOMB OF THE WASHINGTON OBSERVATORY.

This was a description of the preparations in this country for the great astronomical event of next December. The first steps in respect to the observations on the Transit of Venus were taken in Washington four years ago. The plan adopted divided itself into three parts; the nature of the observations; the stations to be chosen, and the organization of the parties of observers. The fundamental idea of the methods adopted was then stated. The two classes of determinations were, on the one hand, observations of interior and exterior contact, and on the other, measurements between the centers of the bodies observed. There are also the visual method and the photographic method.

Hitherto the visual method, however employed, has proved very uncertain. It is now about 200 years since Halley observed a transit of Venus at the Island of St. Helena. The absolute accuracy of his observations cannot now be accepted. The difficulty is in knowing the exact moment of the ingress or egress of the planet from the sun's disk. The approach of the two points of light when the planet cuts the disk of the sun is a matter not only of the most delicate observation, it is a point in which an intrinsic uncertainty is involved. Even at the last transit of Mercury, observers differed enormously in noting the time of disappearance of the dark line of sky which separated that planet from the sun.

DIFFICULTIES IN OBSERVING A TRANSIT.

The best way to ascertain the conditions of this phenomenon is by the observation of the transit of an artificial Venus over an artificial sun. This was done, rather more than a year ago, at the high point visible from the Observatory. The artificial sun and planet were placed on Wilder's building, at a distance of 3,300 feet, in order that full effect might be given to atmospheric vapors and softenings of the outline. The apparent dimensions of the artificial sun and planet were those that will be presented by the real bodies at the time of the transit. It is found that

the sun looks a little larger and the planet a little smaller than their true magnitudes. When the light of the sun is close to the planet the space between is apparently filled by a ligament known as the black drop. It is commonly supposed that the moment of disappearance of the black drop is the moment of contact; but the uncertainty thus occasioned is of serious moment. It is not due merely to a bad atmosphere; it is an absolute effect independent of this cause. In observing the artificial Venus the same difficulty is more or less encountered. Even in a fairer atmosphere than we hope for at the time of the transit we must expect this phenomenon.

In moving toward the edge of the sun, before reaching it, there is again a similar source of error. A cloud seems to pass through the thread of light between the planet and the edge of tho sun; tho bright line grows darker and darker, and at last disappears—that being the moment of true contact. No ordinary observer can fix this time with accuracy. Another method has been suggested—observation by photography; but the difficulty here is that the photograph is dependent upon the comparative actinic power of the thread of light, and every photographer knows that the slightest haze will make a difference in the impression on the sensitive plate. The light thrown on one plate may be five or even ten times greater than on another without any corresponding difference in the facts. I think we shall not attempt tho photographing of the interior contact.

It was supposed that the movement of Venus into the sun's atmosphere could be observed by means of the spectroscope with great accuracy; but a committee in Germany, including Zowlner and Awers, came to the conclusion that this was after all one of the most uncertain methods, and it was finally given up entirely. It has been found, however, that the moment when the planet first makes a notch on the sun is a well defined occasion, and the experiments of Striibner of St. Petersburg agree with ours on tho artificial Venus in this particular. Another method of determining this problem consists in observing the distances of the centers of the two bodies. The Germans thought of doing this by means of heliometers; but the use of the necessary number of these instruments is impracticable, as they are cumbrous and expensive. I believe there is not a heliometer in this country.

The American method of photographing the transit has been already published: this is tho method of Prof. Winlock, and experiments have shown that it is likely to be eminently successful. The photograph is taken by means of a horizontal telescope into which the image is deflected. It was at first supposed that the measures could be taken direct upon the photograph; but this has elements of inaccuracy, except by the method of photography devised by Prof. Winlock. The other methods of photography will not give a closer approximation, according to M. Delarue, than one minute of arc; but we have already much closer measurements of the solar parallax than this would provide. Our present uncertainty does not exceed thirty-four hundredths of a second. Such photographs would be of no value. Tho method of Prof. Winlock was then described.

STATIONS AND ORGANIZATION.

Let us now consider the matter of stations. Suppose for instance that we had four stations, two northern and two southern. If these were divided into two classes of observations, A and B at tho north and A and B at the south, as A is not comparable with B, the failure of either A at the north and B at the south, or B at the north and A at the south, would render all the four observations valueless. Therefore, all the observations will be of the same character. The chief element in selecting stations has been their meteorology, the question at issue being their liability to bad weather at the time of the transit. About two years ago circulars were sent to American Consuls in almost every part of the world where the transit is visible, to ascertain the condition of the weather at those points in November and December, and every other source of similar information was utilized. We had thought of selecting from a number of others Hurd's Islands in the Southern Indian Ocean as being one among the best stations. Northern stations with probabilities of good weather are easily to be had. Especially favorable in this view is Peking in China and Vladivostok in Siberia. In Japan the weather is scarcely as favorable. Hakodadi was very objectionable in respect to weather; Yokohama was just as bad; Nagasaki was rather better.

The only satisfactory station in the southern hemisphere in respect to weather was found to be Hobart Town, in Tasmania. New-Zealand is nearly as favorable. But from all tho other proposed Southern stations the accounts were very bad; notably at the proposed station at Hurd's Islands the almost uniform report was "clouds, rain, tempests, and snow;" the chances of observation there did not exceed two-tenths; this station was therefore given up. The most favorable station left at the South was Kerguelen Island, though somewhat neighboring to Hurd's Islands, and that was selected. A party will also be landed, if practicable, at Crozet's Island. In stead of sending four parties to each hemisphere, we shall send three to tho north and five to the south, to equalize the chances as to weather. We hope to get complete results from two parties in each hemisphere.

The following is a list of the chiefs of parties and their stations: Northern stations, Wladivostock, Siberia, Prof. A. Hall, U. S. N.; Nagasaki, Japan, Geo. Davidson, U. S. Coast Survey; Peking, China, Prof. James C. Watson of Ann Arbor, Mich. Southern stations, Crozet's Island, South Indian Ocean, Capt. Raymond, U. S. A.; Kerguelen Island, South Indian Ocean, Lieut.-Commander George P. Ryan, U. S. N.; Hobart Town, Tasmania, Prof. Wm. Harkness, U. S. N.; New-Zealand, Prof. C. H. Peters of Clinton, N. Y.; Chatham Island, South Pacific, Edwin Smith, U. S. Coast Survey. The constitution of each party is such that in case of disability on the part of its chief, the second officer can take his place. Each party will have three photographers—a chief photographer, who must have been of long experience in the business; an assistant that has had practice, and a second assistant trained only for the occasion. Nearly all the second assistants' positions have been filled by students or graduates of various schools and technological colleges throughout the country. The parties for the southern station will sail, we expect, about June 1. These are all ready; the photographers are to be in full practice here next week. The northern parties will go later and not all together. The Navy Department has furnished a ship, the Swatara, to go to the southern stations. The longitudes of the stations will be determined by occultations wherever telegraph communication is impracticable; but already there is such communication between Vladivostok and Hobart Town. Arrangements are made with the Governments for exchanging longitude signals, and the prospect of the extension of cables to New-Zealand and other points gives fair hope that there will be only a few points where the method of occultations will be the sole resort.

THE COLORADO CAÑONS.

BY MAJOR J. W. POWELL.

This was an elaborate descriptive essay, an account of the progress made in the survey of the Colorado and its tributaries by parties under direction of the Smithsonian Institution. The following extracts show the character of the country:

The whole region embraced in the survey is a cañon country. At the very beginning we have a series of cañons through the Uintah Mountains, as the channel of Green River, Flaming Gorge, King-fisher Cañon, Red Cañon, the Cañon of Lodore, Whirlpool Cañon, and Split Mountain Cañons. Then Yampa Cañon, the cañon along the lower course of the river of the same name, and many other tributary cañons. Then below, in descending the river, the Cañon of Desolation, Gray Cañon, Labyrinth Cañon, and Stillwater Cañon, with their laterals; then Cataract Cañon, a profound chasm below the junction of the Grand and Green, then Narrow Cañon, which terminates at the mouth of the Dirty Devil River; many cañons lateral in all these have also been explored.

Along all the streams mentioned we have series of cañons, and yet all of these represent but a part of the cañons explored and mapped, for there are many profound chasms, the channels of intermittent streams, dry during the greater part of the season, that are hundreds of feet deep, and that never have a continuous stream for their entire length. But I cannot stop to enumerate all of these dry gorges.

Then Glen Cañon, a beautiful chasm carved by the river, in the bright-red homogeneous sandstone of Triassic age. From the mouth of the Paria River to the mouth of the Colorado Chiquito is the beautiful gorge to which we have given the name of Marble Cañon. The walls are of limestone, and near the foot are of a crystalline structure which receives a beautiful polish; white, gray, slate-color, pink, brown, and saffron-colored marbles are here found, carved and fretted by the waves of the river, and polished by the floods of sand which are poured over the walls during the seasons of showers, giving to the walls of the cañons, which have assumed architectural forms on a giant scale, an appearance of great beauty and grandeur.

Then we have the Grand Cañon, the most profound chasm known on the globe. Were a hundred mountains, each as large as Mount Washington, plucked up by the roots to the level of the sea and tumbled into the gorge, they would not fill it.

Perhaps the most wonderful of the topographic features of this country are the lines of cliffs, escarpments of rock separating upper from lower regions by bold, often vertical and impassable barriers, hundred or thousands of feet high and scores or hundreds of miles in length. I will enumerate some of the more important. First, we have the Brown cliffs, an escarpment which forms the southern boundary of the plateau through which the Cañon of Desolation is carved; then the Azure cliffs, the southern escarpment of the plateau through which Gray Cañon is cut; then the Orange cliffs, a broken escarpment, which commences at the foot of the Sierra La Sal, on the eastern side of Grand River, past the Grand, then across the Green River, and then down in a south-westerly direction parallel to the Colorado River about fifty miles, and then turns again to the south-east and crosses the Colorado, terminating in the slope of the Sierra La Sal, two or three scores of miles south of the initial point. Thus the head of the Colorado, the junction of the Grand and Green, is encompassed by a towering wall—the Sierra La Sal—on the east; on the north, west, and south the Orange Cliffs; on every side a facade of storm-carved rocks is presented. The Indian name for this basin is *Tum-pin wu-neir tu-weap*, the land of standing rocks. Buttes, towers, pinnacles, thousands and tens of thousands strange forms of rock, naked rock of many different colors are here seen; so that before we had learned the Indian name we thought of calling it the Stone Forest or Painted Stone Forest; and these rocks are not fragments or piles of irregular masses, but standing forms, carved by the rain drops from the solid massive beds. Weird, strange and grand is the *Tum-pin wu-neir tu-weap.*

Passing by many others, let us speak of three more only. The Hurricane ledge is an escarpment due to a fault having a northerly and southerly direction, starting away to the North of Tokerville, in Utah Territory, and running South across the Colorado River. It probably continues in this direction as a fault or a fold for 400 miles.

The Vermillion cliffs have an easterly and westerly trend; this line then crosses, in an irregular way, the head waters of the Rio Virgin, still on the east crossing the head waters of the Kanab and the folds around the northern extremity of the Kaibab plateau, then crosses the Colorado and turns in a southerly direction across the Little Colorado by a monoclinal fold. This escarpment presents a wall of triassic red sand-stone, and is due to erosion; the beds below have been stripped away by the rains and rivers.

White cliffs are approximately parallel to these; the line is a broken angular escarpment in jurassic limestone and homogeneous gray sandstone, capped by beds of limestone.

To the knowledge of the geography of this country we have given a great number of plateaus. Those along the course of the Green and Upper Colorado I may not stop to mention. Geographers and geologists have heretofore spoken of a great Colorado plateau, referring to the district of country through which Marble and Grand cañons are cut, for so it appeared to the observer standing on the south-west margin of this great district of country; but it has proved, in fact, to be a complex system of plateaus, bounded by walls of faults, escarpments or cliffs of erosion, and cañon gorges. Chief among these are the Mark-a-gunt, Pauns-a-gunt, Aquarius, and Kai-por-o-wits plateaus, lying to the north in the surveyed district, and in which head the Dirty Devil, the Escolante, the Paria, the Kanab, and the Rio Virgin Rivers. The upper beds of which these plateaus are composed are of tertiary age, but they carry on their backs extensive outflows of lava and numbers of dead volcanoes. The numerous plateaus, mesas, and terraces to the south of these are composed of beds of cretaceous and jurassic age, but I pass them by without further mention. The Paria plateau, on the south side of the river of the same name, is a great table of trias. On the north side of the grand cañon we have the Kaibab, the Kanab, the Vin-karet and Shevwitz plateaus. These are extensive tables of carboniferous age with many eruptive masses and volcanic cones. For the great plateau to the south of the Colorado River, bounded on the north by the grand cañon, on the south-west by an escarpment, which is the continuation of the Hurricane ledge, but which in this locality has received the name of Aubrey cliffs, and on the north-east by a great escarpment which faces the Little Colorado, and whose eastern boundary is not determined, I propose to retain the

name originally given to the whole series of plateaus—Colorado plateau.

These plateaus can be thrown into classes on geological grounds, as follows: The tertiary plateaus to the north, cretaceous plateaus immediately south, triassic plateaus next in order, and carboniferous on the south. The geological classification serves well, also, for geographic purposes, as each group has peculiar topographic features, depending on the texture and structure of the rocks of which they are composed.

A VARIETY OF SUBJECTS—Third Day.

AN INSTANCE WHERE SOLAR TIDES EXCEED THOSE CAUSED BY THE MOON—A NOVELTY IN INORGANIC CHEMISTRY—THE THEORY OF CYCLONES—NEARLY ALL THE ATMOSPHERE OF THE EARTH TWO HUGE CYCLONIC WHIRLS.

Washington, April 23.—Disagreeable weather tended to reduce the audience of April 23 at the Smithsonian Institution. The subjects discussed did not equal in general interest those of the previous day, but they had at least the merit of bringing forward some novelties in scientific discovery. The statements of Prof. Ferrel respecting the tides of Tahiti were curious rather than important. The discoveries of Prof. Gibbs of Harvard, who is equally noted as an original investigator, and as an editor of *The American Journal of Science and Arts*, of compounds in inorganic chemistry having the characteristic of metamerism that has hitherto been unknown except among organic substances, seems to open a new field of research. Prof. Gibbs mentioned that he had given no name to his new compounds; for which we may be truly thankful, since names that chemists are apt to indulge in when making discoveries in organic chemistry, are rarely limited by six or seven syllables and sometimes reach a dozen.

The communication from Prof. Alexander, the distinguished astronomer of Princeton, suggests a very interesting though difficult inquiry. Prof. Hayden gave a glowing and rapid sketch of the explorations in which he has been engaged, and of the work accomplished and under way. He was warmly greeted by several of the professors, who evidently held his work in high esteem. Prof. Silliman told of the localities of the American ores of tellurium—that curious substance which once on a time a bold experimenter swallowed, the result being that his friends dropped off gradually. He noticed after a few days that everybody seemed to avoid him. Finally he cornered one of them and begged an explanation. "Why, the fact is," said his friend, with his nose in his handkerchief as he spoke, "you must be aware that you have a horrible smell." The experimenter was obliged to retire into obscurity for some weeks, till the tellurium was out of his system. Prof. Ferrel's theory of the law of cyclones was exceedingly interesting to the meteorologists present.

THE TIDES OF TAHITI.

BY PROF. WM. FERREL OF THE U. S. COAST SURVEY.

In 1856 the U. S. Coast Survey took advantage of the surveying expedition under charge of Capt. (now Commodore) John Rodgers to obtain a series of tidal observations at the Island of Tahiti in the Pacific. A self-registering tide gauge was sent by the Coast Survey, and left by the expedition in the hands of a French soldier at the town of Papeetee on that island. By this means a series of observations nearly complete was obtained from June 1 to Oct. 1. These were reduced by the Coast Survey and published in the report of 1864. The great peculiarity of these tides is that the solar tide is for the most part greater than the lunar tide, although the force producing the latter is more than double that producing the former. There is only one other case of the sort in the world—at Courtown, Ireland. It is not, however, due to any exception in the general theory of the tides. Certain constants in the tidal expressions, which have to be determined by observations, are unusually large in this case. It is yet impossible to specify, however, what are the irregularities of ocean bottom and of coast outline which occasion the phenomena in this particular instance.

A representation was here given by diagrams of the solitidal intervals; *i. e.*, a mean of the curves for morning and evening tides, as furnished in the Coast Survey Report. The small diurnal tide was eliminated from the representation, which only gave the semi-diurnal tides. The solitidal intervals were given instead of the luni-tidal, because the former were the larger. In June, however, at the time of the quadratures, when the solar and lunar forces are in opposition, the sun has its greatest declination, and the moon is near the equator, and hence the solar tide is smaller and the lunar greater than usual. Hence also, in June and July, the times of high water at the quadratures follow the moon, and the range of the solitidal interval is from 0 to 12 hours. But toward September, at the quadratures, the moon is near its maximum declination and the sun near the equator, and hence the solar tide is larger than usual and the lunar smaller; and the times of high water follow the sun rather than the moon, and occur within a range of three or four hours near noon and midnight.

From theoretical considerations applied to the observations, it was, however, shown that the observed times of high water in the small tides, affected by abnormal disturbances of the winds and changes of barometric pressure, necessarily differ considerably from the theoretical calculation, which merely depends on the forces exercised by the sun and moon.

METAMERISM IN INORGANIC CHEMISTRY.

BY PROF. WOLCOTT GIBBS OF HARVARD UNIVERSITY.

Although this paper was of a technical character, and its greatest value is of course to those who are interested directly in chemical researches, it presents a discovery so novel in its character that it can scarcely be without interest even to the non-professional student. Hitherto what has been denominated metamerism has never been observed except in organic substances. Bodies are said to be metameric when they are of the same composition and atomic weight, but differing entirely in their properties, in consequence of different molecular constitution. Prof. Gibbs has discovered six such bodies bearing such a relation to one another and to a seventh which was not of his discovery.

That is, if you were to take these seven substances and separate each into its ultimate constituents, you would find each giving not only the same materials to ultimate analysis, but weight for weight the same amounts of these materials; and yet each of the seven substances is intrinsically different from the other in its character, appearance, and chemical reactions; and no one of them can be transformed into the other. In the whole realm of inorganic chemistry there has been no similar instance recorded, although among organic bodies there are not a few such cases.

The substance with which the series begins was discovered by Dr. Eidmann. It is an exceedingly stable compound. Its constituents are two parts of cobalt, six of ammonia, and six of nitric oxide. Its chemical formula is:

$$Co\ 2\ (N\ H\ 3)\ 6\ (N\ O\ 2)\ 6.$$

The six other bodies metameric with it, were obtained by Prof. Gibbs by making the compounds and combining them when made, in the manner indicated in the notation which follows. It will be observed by the chemist that the combination of the compounds is that of an acid with a base, in each instance making a true salt, obtained in crystalline form. For the sake of abridgement in notation, in what follows, the ammonia (N H 3) is represented by A and the nitric acid by X. On account of the difference in their atomic constitution, Dr. Gibbs divides the seven substances into three series.

First series—Eidmann's discovery:

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Co\ 2\ A\ 6\ X\ 6$$

Second series—Dr. Gibbs's discovery:

$$(Co\ 2\ A\ 4\ X\ 8)^{II}\quad (Co\ 2\ A\ 8\ X\ 4)^{II} = 2.\ Co\ 2\ A\ 6\ X\ 6$$

$$(Co\ 2\ A\ 4\ X\ 8)^{II}2\quad (Co\ 2\ A\ 10\ X\ 2)^{IV} = 3.\ Co\ 2\ A\ 6\ X\ 6$$

$$(Co\ 2\ A\ 4\ X\ 8)^{II}3\quad (Co\ 2\ A\ 12)^{IV} = 4.\ Co\ 2\ A\ 6\ X\ 6$$

Third series—Dr. Gibbs's discovery:

$$(Co\ 2\ X\ 12)^{VI}\quad (Co\ 2\ A\ 12)^{VI} = 2.\ Co\ 2\ A\ 6\ X\ 6$$

$$(Co\ 2\ X\ 12)^{VI}\quad (Co\ 2\ A\ 8\ X\ 4)3 = 4.\ Co\ 2\ A\ 6\ X\ 6$$

$$(Co\ 2\ X\ 12)^{VI}2\quad (Co\ 2\ A\ 10\ X\ 2)3 = 5.\ Co\ 2\ A\ 6\ X\ 6$$

As each of the salts thus obtained is beautifully crystalline and perfectly well defined, and each salt of the second and third groups gives the reactions of each constituent with perfect distinctness, no doubt can exist as to their real chemical structure.

COMPARATIVE VELOCITY OF LIGHT IN AIR AND IN VACUO.

BY PROF. STEPHEN ALEXANDER OF PRINCETON COLLEGE.

This brief paper merely contained a few interesting suggestions on a small correction of the velocity of light as deduced from experiment.

In accordance with the undulatory theory the velocity of light must be less in atmospheric air than in vacuo, in the inverse ratio of the index of refraction of atmospheric air to 1: that is, as 1 to 1.000294. The velocity then as ascertained by experiment under the air should be increased by just about 0.000294 of itself to be equal to that in vacuo; *i. e.*, to the extent, almost exactly, of 55 miles per second; a very small quantity indeed in comparison with the whole velocity of 185,000 miles per second; and yet small as it is—and so small as to be below the limits of error of the experiments in question—it is yet very closely equal to three times the velocity of the earth in its orbit.

It is an outstanding excess, and no more, with which we often have to do, as, for example, in the measurement of temperature; but the scale on which those differences sometimes present themselves makes them, small as they may be in their original comparison, grand in comparison with ordinary standards. Prof. Alexander was not aware that anything has yet been put forward elsewhere on this subject.

Prof. Hilgard remarked that the postulate of this paper that the undulatory theory required that light must move more slowly in air than in vacuo, was not by any means settled. There had been an approximate experiment—on aberration, by Prof. Airy, who filled a telescope with water and sent light through it—but no deviation was observed after the most careful observations. We are not sufficiently acquainted with the character and properties of the luminiferous ether to speak with certainty on these subjects, but the investigation is well worthy of the highest effort. Prof. Henry spoke a few words of merited praise about the communication.

RECENT WORK OF PROF. HAYDEN.

SUPPLEMENTARY TO TRIBUNE ACCOUNTS OF EXPLORING EXPEDITIONS AT THE WEST.

Prof. F. V. Hayden appeared before the Academy to give a general account of the scientific explorations and survey at the West in which he has been engaged. As full accounts of these explorations have appeared in THE TRIBUNE it will be unnecessary to reproduce the details with which our readers are already familiar. The following particulars are concerning more recent work and bring the story of these explorations from the accounts in THE TRIBUNE Extra of Dec. 30th to the date of the meeting.

The party returned from the field-work in Colorado in October and at once commenced the preparation of the annual report and the construction of the maps. The seventh annual report, containing the preliminary results of the survey for 1873, will be ready for presentation to Congress in May, and will form an octavo volume of about 800 pages, with over 300 illustrations, sections, profiles, maps, &c. The geological and mineralogical, as well as topographical, structure of the remarkable mountain region of Colorado has been worked out with care; sections of all the mines have been made with the utmost attainable accuracy, showing the connection of the mineral lode with the country rock, so that the light which will be thrown upon the origin and history of these formations will be of great value to science. Two classes of maps, on a scale of four miles to one inch, have been prepared. The first class are in contour lines of 200 feet, upon which to represent the various geological formations in the areas explored, with suitable colors. On the second class the peculiar mountain forms will be delineated, in excellent relief, by a peculiar kind of brush-work. These are the topographical maps. When the survey of Colorado is completed the great features of the physical history of that Territory will be summed up in one volume, with an atlas of maps and sections. Prof. Hayden regarded this work as a contribution from the General Government to its ward, the Territory, toward the development of its resources. It will also form the basis upon which more detailed surveys can be carried on by the community itself. Dr. Hayden closed with an appeal to the members of the National Academy to spare no effort to enlist the continued sympathy of Congress in the great work of making known to the world the unexplored portions of our public domain.

Prof. Henry said that we are inviting thousands of foreigners to come here, and we ought to be able to tell them what we have to offer them. For this purpose a survey of the whole United States ought to be made. We have three organizations for this purpose—the Coast Survey, the Engineers' Survey, and this Civilians' Survey. It is very desirable that there should be no wrangling between these organizations; that their work be brought into coördination and unity. He recommended that the Academy take this matter into consideration, and perhaps suggest the formation of a commission.

Prof. J. Lawrence Smith of Louisville, Kentucky, followed up this observation with one on the lack of unity in the State surveys. His own State suffered much from the need of correct surveys from fixed points determined by the Coast Survey. It is exceedingly desirable that the method and system of all surveys be placed under one head and conducted with uniformity.

Col. Forshey of Louisiana enforced the foregoing views by his experience in that State and remarked also on the value and interest of Prof. Hayden's work. In the matter of hydrographic surveys there was almost an equal deficiency of unity of plan and useful results.

Gen. Barnard of Washington referred to the extreme difficulty that was found in conducting the operations of the war without maps of a topographical character. He considered that much of the delay which characterized our undertakings in the war was principally due to our ignorance of the country where they were carried on—an ignorance of topographical details paralleled in no European country.

He also alluded to the difficulties which ordinary civil engineering operations find in our deficient surveys. The opening of a water supply, for instance, where a canal or railroad was being constructed, could not be predicated with any certainty when the geological and topographical features of a section of country were almost unknown.

Col. Forshey was glad to hear the proposition (suggested by Prof. Henry) that a Commission be appointed to unify the surveys throughout the United States.

Prof. Henry mentioned, in the absence of Dr. Bessel, that the entire scientific operations of the Polaris were under his management, and that his report of the work effected during the voyage of that vessel would be presented to the Academy, in accordance with the provisions of the acts of Congress concerning that expedition.

MINERALOGICAL NOTES.

BY PROF. B. SILLIMAN OF NEW-HAVEN.

The subject which he proposed to treat was the telluric ores of Colorado. The rocks are principally gneissic, and granite with excess of feldspar or quartz. At the place where the mineral is found there is a remarkable dyke of 50 feet in thickness. It is on the side of this dyke that the mineral containing the little-known substance tellurium is found. Prof. Silliman showed the evidence that the tellurium was introduced by the plutonic invasion of this dyke. He had found in many instances that telluric ores were associated with gold, and the association was very unfortunate for the gold miner, as in one instance $3,000 worth of gold thus associated was thrown away (through ignorance), while the yield of the rest of the ore was only $40 or $50 to the ton. Prof. Silliman asked Prof. Endlich to perform an experiment, showing the presence of tellurium by using concentrated sulphuric acid. A bright purple color was rapidly obtained when the ore was thus treated with heat, in a test tube. In one specimen of these telluric ores there was $55,000 extracted from a ton. Specimens of telluric ores were exhibited, and Prof. Silliman mentioned that these and many other very valuable specimens, now the property of the Smithsonian Institution, were procured in Prof. Hayden's surveys.

ON THE LAWS OF CYCLONES.

BY PROF. WILLIAM FERREL OF THE COAST SURVEY.

There were at one time two rival theories with regard to the motions of the atmosphere in cyclones. According to Espy's theory, called the radial theory, the atmosphere flowed in from all sides toward the center in the direction of the radius, and ascended in the middle of the cyclone and flowed out above. According to Redfield, Reid, and others, the motion of the atmosphere above and below was that of a circular gyration around the center of the cyclone, and there was no motion either to or from the center.

In the year 1859 in a paper published in *Runkle's Mathematical Monthly*, Prof. Ferrel first demonstrated the effect of the earth's rotation upon any body moving upon its surface, which was to cause a deflecting force at right angles to the direction of motion, to the right hand in the northern hemisphere, but to the left in the southern. It was also shown that the effect of this deflecting force upon air tending from all sides toward a center, was to cause it also to gyrate around this center, and that consequently Espy's theory could not be true. If the atmosphere has a circular gyration, the deflecting force arising from the earth's rotation is in the direction of the radius from the center, and causes a depression and low barometer in the center; but there is no force to overcome the resistance to the gyration, and hence the atmosphere is soon brought to a state of rest. There must, therefore, in all cases be some motion below, toward the center of the cyclone, so that the deflecting force—depending upon the earth's rotation—arising from this component of the motion, may overcome the resistance to gyrations; else the gyration soon ceases. The resultant of the gyratory motion and the motion toward the center gives a motion, the direction of which makes an angle with the isobar, or line of equal barometric pressure. (Here Prof. Ferrel drew a circle on the blackboard, showing the line of the isobar in a perfect cyclone.) The greater the resistances, the greater this angle must be, and hence, since resistance is as the square to the velocity, all other things being the same, the more rapid the motions of the atmosphere in the cyclone, the greater must be this angle. (The angle was shown on the blackboard as formed by a tangent to the circular isobar.)

On the open sea, where the amount of resistance is small, especially when the velocities are not very great, this angle must be small, and the gyrations nearly circular, as Redfield's theory requires. In violent tornadoes on land, where the resistances are very great, this angle

is large, and the directions of the motions at the surface do not differ much from those of the radii, and hence there is an approximation to Espy's theory. As Espy took his observations mostly from tornadoes on land, and Redfield took his mostly from large cyclones at sea, each one had observations which, with a little bias in its favor, seemed to verify his theory. Until recently, no considerable number of observations have been discussed to determine from observation the truth of the preceding laws adduced from theory. The Rev. Clement Ley recently, from a great number of observations made by the signal service of England, France, and Holland at 15 stations, has determined that the average for the angle between the direction of motion and the isobar for all the stations is nearly 21 degrees, and hence has verified the theoretical law above. By taking the average, also, for five stations on the coast, where the resistances, since part of the gyration is on the sea, are less, he found the value of this angle only 13°, while for five other stations entirely inland, where the resistances are greater, the average gave 29° for the value of this angle. This verifies another part of the theory above, namely, that the greater the resistances the more must the directions of motion deviate from that of the isobar, and consequently the more must the gyrations deviate from the circular gyrations of Redfield's theory.

When Mr. Ley considered the observations separately from the different quarters from which the wind blew, he obtained for the angle of deviation from the isobar 51 degrees on the N. E. side of the cyclone, 18 degrees on the west side, 9 degrees on the S. W. side, and 20 degrees on the S. E. side. He also states that the average directions in which the cyclones move is toward the N. E. Hence the angle between the direction of motion and the isobar for the front part of the cyclone seems to be much greater than that for the rear. For this no very plausible reason is apparent, but several probable explanations might be given.

It is commonly supposed that the gyrations of a cyclone in all parts are the same way, that is, from right to left in the northern hemisphere, and the contrary in the southern hemisphere; but this is not the case. In every cyclone in the northern hemisphere the gyrations are from right to left in the interior part, while they are from left to right in the external part, but the gyrations in the interior are much the more rapid, the motions of the exterior gyrations amounting usually to only gentle winds. The highest barometric pressure is on the dividing line between the two systems of gyrations.

As the motion toward the center in the lower part of the cyclone causes the direction of the wind to deviate from the isobar on the side toward the center, so the outward motion in the upper part of the cyclone must cause the direction of the wind to deviate on the side from the center, and there must be a certain median plane where there is no motion either toward or from the center, and where the direction of the wind must coincide with that of the isobar, that is, where the gyrations are entirely circular. If, therefore, an observer stands with his face exactly toward the wind below, the clouds in the upper strata, moving with the directions of the wind there, must always come from a direction a little to the right of the observer, and the higher the clouds in general, the greater must be the difference in the directions.

Beside the ordinary cyclone of which we have treated, there is also what is called an anti-cyclone. In this kind of cyclone the denser and heavier part of the atmosphere is in the center, and hence the air descends there and flows out on all sides below, and in from all sides above, and hence the motions in a vertical plane are just the reverse of those of an ordinary cyclone. For this reason it is generally supposed that the horizontal gyrations are also reversed in an anti-cyclone; but this is a mistake. The gyrations in both cyclones are precisely the same, and such as have been given for the ordinary cyclone. Anti-cyclones are always stationary; having their centers in the interior of a continent or larger island where the atmosphere in Winter is colder and consequently heavier than over the surrounding sea; and hence it descends in the middle and flows out at all sides below, and the deflecting force already explained gives rise to a stationary cyclone.

Each hemisphere of the earth contains one grand anti-cyclone, with the cold Pole in the center and the one-half of the torrid zone for its external warmer part, and in these anti-cyclones we have a verification of what is stated above, since in the northern hemisphere the gyrations nearest the Pole are from right to left, giving rise to the eastward current in the middle and higher latitudes, while toward the external border at the equator the gyrations are the contrary way, giving rise to the general westward motion of the air in the torrid zone. In this case, also, as in ordinary cyclones, the barometer stands the highest at the dividing parallel of latitude of about 35 degrees, which separates the two systems of gyrations or winds.

At the business session, Prof. F. A. P. Barnard, President of Columbia College, New-York, was elected Foreign Secretary, vice Prof. Agassiz, deceased. The constitution and rules limit the number of members to be elected annually to five. The following individuals were honored by election April 23: Prof. C. F. Chandler of New-York, chemist; Geo. Davidson of San Francisco, mathematician and astronomer; Prof. O. C. Marsh of New-Haven, Conn., geologist; George W. Hill of Nyack, N. Y., mathematician; Prof. Henry Morton of the Stevens Institute, Hoboken, N. J., physicist.

LAST DAY OF THE MEETING—HASTE FOR THE SAKE OF ADJOURNMENT.

SCIENTIFIC VALUE OF THE POLARIS VOYAGE—AN INTERESTING DEBATE ON THE FORMATION OF THE NORTHERN PART OF THE CONTINENT—THE GREAT TELESCOPE A GREAT SUCCESS—OTHER SATELLITES LIKE OUR MOON—LAWS OF STORMS—SILURIAN FOSSILS.

WASHINGTON, April 24.—It was evident when the session of the day began, that the Secretary, Prof. J. E. Hilgard, was pushing matters with unusual rapidity. There were many papers of interest and value that had been under consideration, which were either declined, read by title (that is, not read at all, except the title) or hurried through with little ceremony. Two or three times a rising debate on the subjects presented was brought to a close by an appeal from the Secretary urging haste. And, to the surprise of most of the members and all of the audience, the Academy did actually finish its proceedings and finally adjourn at the usual hour of closing the session for the day.

If those who imagine that the work of Polar expeditions is a mere useless expenditure of enthusiasm

could have been present at this meeting, and seen the deep interest taken by all the members of the Academy in the scientific results of the expedition of the Polaris, they might have found cause for changing their opinion. In this memoir and the debate which followed nothing was more evident than that in order to obtain a satisfactory answer to the many unsolved questions of the history of the earth an immense number of facts is yet to be amassed, which can only be procured by new expeditions to the higher latitudes. In the interest of science alone, Polar expeditions are of the highest order of value.

Everybody that takes the least interest in astronomical science is anxious to know whether the great telescope in Washington, with the largest achromatic lens ever constructed, is really a good instrument, and whether it has met the sanguine hopes entertained during its construction. To such inquirers, Prof. Newcomb has given a most interesting and a categorical reply that is perfectly satisfactory. The astronomical paper furnished by Prof. Alexander seemed to tear away the last hope of habitability in any part of the solar system except the earth. Prof. Proctor has shown that none of the primary planets were fit to be the abodes of life; and Prof. Alexander now disposes similarly of the satellites. Those interested in meteorology found much of interest in the calculations of Prof. Loomis concerning the law of storms; and Prof. Newberry gave information of scientific value respecting fossil plants of the Silurian age.

RESULTS OF THE POLARIS EXPEDITION.

BY DR. E. BESSELS.

This manuscript was entitled the History of Smith's Sound from a Geographical and Geological Point of View, and some other General Results of the Polaris Expedition.

It is probable that Smith's Sound must be regarded as the best of the three gateways to the pole. A channel of almost 300 nautical miles long, and in some places scarcely 25 miles wide, separates Greenland from Grinnell Land and the archipelago south of it. Connecting it with Baffin's Bay and Davis's Straits, we can regard this channel as one having for its geographical homologue only the Red Sea. It was discovered in July, 1616, when Bylot and Baffin, in smacks of 36 and 50 tons, sailed through Davis's Straits to 77° N., when Baffin discovered Smith's Sound and described it as a deep bay. For more than 200 years the east and west capes of the Sound were the northern Pillars of Hercules.

John Ross in 1818, nearing the Sound, described it as bounded by a range of elevations, which he named Dulcina Mountains. Inglefield, in 1852, searching for the survivors of the Franklin Expedition, sailed over the locality of these imaginary mountains, and reached 78° 28′ N., which has been passed only twice since. The most northerly points determined by him are Pelham Point of the east and Cape Sabine of the west coast. Kane followed on the heels of Inglefield the next year, and reached with his ship latitude 78° 37′. One of his sledge parties traveled to Cape Constitution, 80° 25′ N., sighting land beyond on the west coast in 82°. He supposed erroneously that Cape Constitution was the northernmost point of Greenland. Thirteen years ago Hayes reached the boundary of navigable water in the Sound at latitude 78° 18′, and could penetrate no further. The Polaris, under Capt. Hall, was more fortunate, and reached 82° 16′, the highest latitude a ship has ever reached.

The land found between 81° and 82° seems to me to be of great importance in demonstrating that Greenland has been separated from the continent in a south-north direction. That entire tract of land, and probably the whole coast north of Humboldt Glacier, shows Silurian limestone, having at times almost perpendicular cliffs of an average hight of 1,500 feet, with occasionally lower elevations covered with irregularly distributed hills, and mountains not systematically disposed in ranges. Garnets collected in this locality were found identical with some at Fiskernesset, in lat. 62° N., and a very characteristic white quartzite was identical with that of Cape Alexander. Besides these there were collected hornblende rock, gneissic granite, sandstone, and other specimens of rocks found in position considerably south of Polaris Bay—even labradorite like that of the coast of Labrador. The identity of these specimens with rocks near Ita was recognized by several Esquimaux from that place, to whom Dr. Bessels showed them. From these observations he concludes that the direction of the geological drift is from south to north.

On the North American continent in general the main drift of erratic material has been southward from northerly latitudes, a fact paralleled in the North German plain in erratic blocks and débris of Scandinavian origin; in Sweden and Lapland by drift from Spitzbergen; in Iceland by débris from both Spitzbergen and North-Eastern Greenland. Smith's Sound seems therefore an exception to the general rule, and we must conclude that its drift was transported by floating ice-fields and icebergs, and not by glaciers. Among many specimens which Dr. Bessels examined between the degrees of latitude named, he only found one piece showing glacial scratches. This was silurian limestone, identical with and not to be mistaken as other than that of the immediate vicinity. He sought in vain for erratic blocks of this limestone further south than the original deposit. None of it was to be found between 76° and 78°.

Palæontological researches, as well as the fauna and flora of the region, point to the determination that the continent and Greenland were formerly connected. Greenland is now known to be an island. It is a rule in the formation of islands by separation from main land that the sea between will be shallow, especially if its width be inconsiderable. The soundings of Davis's Straits and Baffin's Bay are deeper than would be expected, Dr. Schott having some time ago computed the average depth, by Airy's method, at 250 fathoms. By the kindness of Baron von Otter, Dr. Bessels was supplied with soundings for 6° of latitude, showing a greatest depth at 67° 25′ N. of 930 fathoms, and an average in 28 soundings between 67° 25′ and 74° 04′ of 290 fathoms, corroborating Dr. Schott's computation. With these we may take into account the sounding of Ross at 76° N. and 71° W., giving 250 fathoms, and a sounding probably by the Advance, at 66° N. and 59° W., giving a depth of 288 fathoms.

Along the east coast of Davis's Strait, and its northern continuation, a narrow, warm current flows, moving from south to north at a mean velocity of 0.2 miles per hour, turning to the west off Jones's Sound, and there deflected to the southward by the cold Arctic current. The velocity of the latter differs according to locality and season, but never exceeds 12 miles per day. At Smith's Sound and Kennedy's and Robeson's Channels, the ex-

pedition observed a northerly current with a velocity of 8—12 miles per 24 hours. The current spoken of by Ingelfield as setting north 72 miles per day, near Cape Saumarez, must have been a local eddy near the coast—an eddy into which the Polaris was once drawn and carried rapidly to the northward. At all other localities the current flows to the south. That this current cannot carry any drift material from south to north is evident.

Still, we find between 81° and 82° minerals and rocks that doubtless had their origin in South Greenland, indicating that the current must at some time have had the opposite direction. This condition could only have been produced by the fact that the separation of Greenland from America must have occurred in the same direction that the current flowed. The outlines and form of Davis's Strait tend to strengthen this view. That the southern end of the strait is the older is apparent from the fact that the southern portion of it is evidently broader than the northern; and also the fiords on the south-west coast of Greenland are by far more numerous and deeper than further north. Let us construct an ideal current chart of that period, when both countries were yet united. According to the theory, a warm current must have moved along the east coast of America, and must have entered Baffin's Bay, having the full strength of an unweakened current in washing the end of that bay. Thereby considerable atmospheric precipitation as rain was occasioned, accelerating the growth of the glaciers, which moved on toward the valleys, and there formed spurs. The fiords we must consider as the former beds of these spurs.

What was the agency which caused the separation, we can only surmise. There are two probabilities; either the channel is a fissure which gradually widened because of the influence of the current, or it has been eroded by the action of a glacier, the south end of which gradually melted down. The latter hypothesis seems the more probable of the two, and we may regard the channel itself as formerly an immense fiord. But we know that the soundings of fiords are usually shallower at the mouth than at the head; while with Davis's Strait and its continuation exactly the reverse is true: the greatest depths are found at its entrance.

In reality nothing else could be expected. We know that the bottom of the North Atlantic is slowly but continually sinking, and has been ever since the miocene period. Among other evidences is the fact that the Bermudas rest on a coral foundation. This motion reaches far north and includes a part of Greenland. At Disco, for instance, the colonial store-house had to be removed from a small island to the main land because its site was inundated by almost every high water.

Further north the land rises. Kane and Hayes saw terrace-like formations, which Herschel regarded as old sea-beaches. The Polaris expedition detected similar appearances. There was decided proof of the rise of the land north of Humboldt's Glacier, and many terraces were seen, though too much weight must not be given to this appearance, as similar terraces can be formed by the melting of snow. In the case of Hall's land, there was evidence of its rise in the discovery of crustacea in fresh-water ponds more than thirty feet above sea level, which could not be reached by the highest Spring tides of 5½ feet. Also, at elevations of 1,800 feet above sea-level, the expedition found marine shells and the balanus, identical with those of animals at present living in the neighboring sea. Later, mixed with these numerous remains were found numerous pieces of drift-wood. The expedition also discovered a fine, limy mud, 1,200 feet above sea-level, showing by aid of the microscope, specimens of *Polythalamiæ*.

These facts as to the rise and sinking of the land must be regarded as important factors in the change of level of the bottom of the seas. It seems probable that the former conditions of depths underwent change, they becoming gradually obliterated, because many icebergs melt in the middle of Davis's Strait and Baffin's Bay, dropping the debris they carry, and gradually producing shoals. That the separation of Greenland from America must have occurred from south to north, seems more than probable. How this took place is as yet an open question, needing for its solution many additional observations.

Dr. Bessels read from the report of the Polaris examination the results of the scientific work of the expedition. This was published some months ago in THE TRIBUNE.

Prof. Newberry made the following remarks in respect to the expedition in which Dr. Bessels had borne so prominent a part:

Some of us will remember how, a few years ago, the matter of the organization of the Polaris party came before us, and the duty devolved upon us of prescribing a formula of observations. Instructions for observing in some directions of science were delegated to the Academy by the Government. Part of that duty fell to my charge; and it became my duty to write out some views which I wished to submit to Dr. Bessels when he left us. That paper was transmitted to him just about the time of the departure of the expedition, and members of the Academy will remember with what sympathy and concern we saw these men take their lives in their hands and go off to the Far North to execute this scientific commission; and nothing is more proper than that we should recognize the importance of the contributions that have been made to science; that we should welcome back those who have gone upon such a dangerous mission, and that we should express our regret that the chief of the party has fallen a victim to his devotion to science.

I shall limit myself simply to the expression of the degree of satisfaction I feel as to the accuracy of the statement that Dr. Bessels has made here, and has made to me personally, in regard to the evidences that are furnished there [pointing to map] of the great changes of level. It may be a matter of a little time and needing a great extent of observation to connect those with the changes we have found in lower latitudes, and in that way to work out plans that can give the physical history of the northern portion of the continent, running through that remarkable period, the glacial, and to connect that with the miocene before, when the temperature was so very different.

This change of elevation to which he has referred I have received notice of with great interest. You will remember that Dr. Bessels mentioned that in the cliffs of Hall's Land there were found, 1,800 feet above the present level, mollusks such as are living in the sea at the present time. We find them all the way down to Lake Champlain, and I have myself collected them there, evidently indicating the effect of the same general depression. We find these rocks with many recognizable shells upon the shores of an ocean perhaps that has prevailed over the far north, presenting an ancient coast line that at times has been washed by the sea waters and at other times was elevated by the erosion that has cut up that great system of fiords. The matter of the transportation of the drift from south to

north is of great importance, and can be certainly known if we could find larger amounts of bowlders with grooved surfaces. In the gradual elevation of temperature, and a diminution of the magnitude of glaciers, there came a time when the glaciers there were local, carrying with them the material by which it passed this coast, and very probably have left those striated bowlders which could hardly have had any other route than such as I have referred to.

I cannot express my own immediate degree of satisfaction in welcoming back Dr. Bessels, who has so faithfully executed the commission we committed to him.

Dr. Bessels replied: I should like to make another remark on the raising of the land. I thought I might find some clue in collecting some specimens of the stems of old willows that grew on that land, and on examining those different willow stems, I found that there was not a single one of them older than 196 years. That is indicated by the number of rings, although I do not think that such a rise as 1,600 or 1,800 feet could have been produced in 196 or 200 years.

Dr. Guyot asked: Will Dr. Bessels please tell us what the diameter of that tree is, which is 196 years old?

Dr. Bessels—These willow stems were a little larger than my finger.

Dr. Guyot—Might I ask Dr. Bessels how he would explain in the transportation to the North the coming of the bowlders from Labrador. It seems that the sea ought to have come as low down as Labrador.

The Chairman (Prof. Henry)—Where would be the point of separation between Greenland and the continent?

Dr. Bessels—The point of separation would probably be in the vicinity of Newfoundland, because in tracing such a line following the coast of Greenland would just exactly give us the shape of the continent required. You will remember that Burckmeister was the first to point out that such a triangle with the points to the south was the shape of the continent. [Dr. Bessels here drew an imaginary triangle on the blackboard.] The apex of the triangle is pointing toward the south, and in tracing the line from the south cape of Greenland to the eastern cape of Newfoundland that would just give the triangular shape required by the theory.

Dr Guyot—That is true; but all that space from Smith's Sound ought to be open, in order to give the drift from Labrador.

Dr. Bessels—Most likely, but that is what I wanted to find out, though we did not find soundings greater than those in the low fiords, and we found the lesser depths toward the north, the greater toward the south.

Dr. Guyot—And the separation would be still in existence on the northern part.

Dr. Bessels—We find the same motion of the earth is existing still in Australia. The little continent Australia is tilting just like a boat under a heavy pressure of sea.

Dr. Guyot—What I want to know is where was the connection between Greeland and the continent. That is the point, and I think that could not be anywhere than just in the southern part.

Dr. Bessels—Well, I think the last connection must have been somewhere in the latitude of Labrador.

Dr. Guyot—Anyhow, this transportation of drift northward is very interesting. All or a part of Bhering's Strait would be open at that time, and the change of separation would interrupt the currents from the Pacific, and change the whole circulation from the Pacific Sea.

Prof. Newberry—We think the circulation of the sea must have changed, because we find that the amount of atmospheric saturation from existing currents is not enough to form glaciers.

Dr. Bessels—It is so very small that the region under consideration could not have been so affected.

The Chairman—Would not the abnormal appearance of the drift be explained by simply supposing that the sea of the North is not coincident with the pole of the earth?

Dr. Guyot—Certainly.

Prof. Newberry—I venture to refer to the fact admitted, that we have traces of the lower Silurian rock stretching through to the utmost point reached north, and the upper silurian, also. The elevation of these series of later deposits has come lower this way, as you know. In the mouth of the St. Lawrence we have these same deposits 500 feet deep in the sea, and down about New-York on the Hudson, 200 or 250. The depression seems to be greater toward the north.

The Chairman then announced that the photographer of the Smithsonian Institution desired to take a photograph of the audience. Thereupon everybody turned about and faced toward the opposite end of the hall. Grave professors ran their fingers through their hair and struck an attitude. A solemn rigidity crept over the spell-bound group, at last to be interrupted by a sigh of relief as the black cloth was finally replaced on the camera.

The next address was an account of the new instrument at the Observatory.

THE GREAT TELESCOPE AT WASHINGTON.

BY PROF. SIMON NEWCOMB.

The initiatory movement in the construction of the great telescope was early in July, 1870, when Congress authorized for it an appropriation of $50,000. The contract was made with Alvan Clark & Sons of Cambridge, Mass., to manufacture it. The price agreed upon for the entire telescope was $46,000. Chance & Co. of England agreed to furnish the glass, they being the only makers of achromatic glass suitable for large refractors. There were many failures in casting the glass disks, and fully a year elapsed before Chance & Co. delivered the glass to the Messrs. Clark; but even this was more expeditious than has been the case in other instances, as at least one order given about the same time had not at last accounts been filled. Alvan Clark & Sons finished the great telescope in October, 1872. It is not too much to say that the glass fully met the high hopes that had been entertained concerning it.

The telescope is mounted on what is known as the German, or rather the Munich plan; but this has not been rigidly adhered to where improvement was possible. Certain important modifications have been made in the machinery by which the instrument is operated; some of these were devised by the Messrs. Clark, and one was adopted from Mr. Cooke's great telescope at Gateshead. As a result of these improvements, the observer can point the telescope by means of the circles alone so nearly that an object shall be in the field of view of the finder without the observer having been required to leave the floor or to look at the object.

The question is frequently asked, How does the new instrument compare with other telescopes? This is difficult to answer, since there are no refracting telescopes in this country of comparable dimensions. The question as to the comparative efficiency of refracting and reflecting telescopes is frequently raised. It must be ad-

mitted that great reflecting telescopes give very variable results and are very apt to prove unsatisfactory As an instance of this, if we examine the record of Herschel's work, we find that nearly the whole of it was done with his two-foot reflector; we shall almost arrive at the conclusion that all the work accomplished with the four-foot reflector might have been done with the smaller instrument. The same comparison of results leads us to a similar conclusion with regard to the four-foot reflector of Lassell—probably the largest ever constructed. He had under the clear skies of Malta made many important observations; but when he took his four-foot reflector there, hoping with it to verify his discoveries, it does not distinctly appear that he succeeded. Struvé, after looking through the four-foot telescope, wrote that it was not in any remarkable degree more powerful than his own 15-inch instrument at Pulkova. The only exception to this generalization is the fact that the four-foot instrument of Lassell did really discover the two inner satellites of Uranus. Prof. Newcomb having rediscovered these with the new instrument, and thus verified Lassell's discovery, thinks that they could never be seen with a 15-inch refractor. In the new telescope the outer satellites of Uranus look as if of about the size that d, *Ursæ minoris* appears to the naked eye. The smaller satellites, strange to say, have been best seen when the moon was shining, and its light was plainly apparent in the telescope; the first of these appears about half as bright, and the second about one-third as bright, as Titania.

It must be admitted that it is impossible to make a refracting telescope perfectly achromatic. The secondary spectrum which is obtained is for certain kinds of observations a serious objection to this class of lenses. This is especially the case where an extremely faint object has to be observed alongside a very bright one. In investigating the working of all ordinary telescopes, if we confine ourselves to the yellow and green rays, we shall find the rays to be brought to very nearly the same focus; but on examining the other rays we find that the red and the blue rays come to a longer focus, while the focus for the extreme indigo and violet rays is so much longer that they form a halo around the star's image. Possibly this can be avoided by adopting a device of the earlier astronomers—by having telescopes of one or two hundred feet in length, and by making changes in the curves of the glass.

The difficulty in a refracting telescope is a theoretical one; it is inherent in the instrument, and can never be entirely avoided; that of a reflecting telescope is mechanical in its nature, but has hitherto proved the more baffling of the two. On the whole, for regular work of almost every kind the refractor is better than the reflector.

Our friends have asked whether there is difficulty in the Washington telescope on account of spherical aberration. This proves to be a very small factor; its total amount is less than that produced in the lens by ordinary atmospheric variations of temperature—an effect which is noticed when work is first begun with the instrument of an evening, but which rapidly wears away as the glass acquires the uniform temperature of the rest of the instrument. It seems to be only the rays near the edge of the glass which are thus affected. Prof. Newcomb has looked through many other refracting telescopes, by way of comparison, and after full consideration he gives it as his unhesitating opinion that the new instrument must be regarded as a great success.

The following paper, in the absence of its author, was read by the Secretary:

THREE OF JUPITER'S SATELLITES.

BY PROF. S. ALEXANDER OF PRINCETON, N. J.

It is claimed that the other satellites of the planetary system resemble our moon in the coincidence of their times of rotation and revolution; and that in consequence every satellite presents always nearly the same side to its primary. One occasion for this belief is found on observing the special vicissitudes which the light of the satellites exhibits, each specified change recurring when they have again arrived at the same position in their orbits around their respective primaries. Another evidence is found in the remarkable phenomena of their apparent loss of light on certain occasions. All Jupiter's satellites, except the second, have at times been seen when in transit on the disk of the planet, appearing in whole or in part as dark instead of bright spots; and sometimes after at first appearing bright they seemed to become dusky. This, as Prof. Alexander has intimated in previous publications, would seem to be due to the absorption of, and possibly also, to the interference of light; *i.e.*, of the light reflected from Jupiter meeting that of the satellite; and all this on a scale such as is only seen in astronomical observations.

The extent of the undulations of light coming from the planet should, it would seem, be greatest where the penetration through its atmosphere and the return are most nearly in a vertical direction, *i. e.*, near the middle of the disk; while near its edges those undulations traversing the atmosphere (both going and returning) with great obliquity, would be more restrained. Accordingly a satellite may sometimes—as it does—appear bright, possibly unusually bright, at its first entrance on the disk of the planet. As it advances, under the partial effect of absorption, &c., it becomes dusky. Near the middle of the transit it seems relatively black, continuing so sometimes to the end of the transit, the passage of the disk being, very possibly, in the region of a bright belt. It is not strange, under these circumstances, that the dark spot should not always be round.

Aside from all this, however, the phenomena in question would seem to be consistent with the theory of a coincidence in the times of rotation and revolution, for the appearance of the satellite in the course of its transit as a black spot has within moderate intervals of succession recurred when the satellite had returned to a like position in its orbit around its primary. Admitting the absorption already indicated, then, instructed by the revelations of the spectroscope, we may regard it as possible that the satellite may be colder than its primary. This would happen—indeed we would have a reason for it—if the satellite, like the moon, had little or no atmosphere. All these analogies would be quite consistent with the hypothesis that all the satellites (including the moon) had been similarly condensed from the nebulous state, and then subjected to the stringent conditions which prevail in satellite systems.

The loss of atmosphere is one of the supposable consequences of those stringent conditions, as indeed M. Laplace has intimated, when, after stating the distance at which the attractive force of the earth is in equilibrium with that of the moon, he adds: "If at this distance the primitive atmosphere of the moon had not been deprived of all elasticity, it would be carried to the earth, which would thus draw to itself (*l'aspirer*). This is perhaps the reason why the moon's atmosphere is nearly insensible."

Système du Monde), (Book IV., chapter 10, conclusion: We may fairly inquire whether this has not been the case with all the satellites and their common experience.

THE LAWS OF STORMS.

BY PROF. ELIAS LOOMIS.

This memoir was entitled Results Derived from an Examination of the United States Weather Maps for 1872 and 1873. It was a continuation of the researches concerning which Prof. Loomis presented a memoir at the Academy's meeting last October, which was at that time reported in THE TRIBUNE. The material employed in these investigations is the United States weather maps for the years above named, one map daily at 7½ a. m. being selected. The method employed is to plot out the line of storms on skeleton maps month by month, reduce the paths to tabular forms by means of a protractor, measuring with reference to a meridian, and thus ascertain the progress of each storm on a scale of inches. Reduced thus to tabular form, the highest velocity is found in February, 31 miles per hour; the lowest in August, 17.7 miles per hour; the average for the year, 25.6 miles per hour. The average direction of the storm paths for the year is N. 82° E., and is found to be 33° more northerly in October than in July; the velocity in February is 75 per cent greater than in August.

The diversity of the direction and velocity of particular storms much exceeds these averages. On Oct. 20, 1873, a storm traveled N. 44° W.; on Oct. 25, 1872, N. 18° W.; on May 10, 1873, N. 160° E., or S. 20° E., showing a range of storm paths of over 180°. The velocities have a range from 0 to 57.5 miles per hour. As the mean values of the storm paths would thus form a very uncertain guide in predicting their velocity and direction, Prof. Loomis undertook an investigation of the disturbances accompanying the storms, using the material afforded by the weather maps. There seems to be a direct connection between the fall of rain and the course of a storm path. The rainfall of each storm was therefore collated, and the distance on each side of the path to which the rain extended. The whole number of storm paths was then divided into four classes, according to their respective velocities, with the following results in 152 cases:

Velocity in miles per hour.	Extent of rain area in miles.	Velocity in miles per hour.	Extent of rain area in miles.
38.8	590	21.6	503
28.5	548	14.5	365

These numbers indicate that the rain area generally extends 500 miles eastward of the storm center; that when the rain area exceeds that extent the storm advances with a velocity greater than the mean, and when the rain area is less, the velocity is below the mean. The comparative acceleration or diminution of velocity can be deduced from the table.

A similar class of comparisons to ascertain the connection of rainfall with the direction of the storm gave the following results:

Course of the Storm.	Axis of rain area.
N. 40° E.	N. 53° E.
N. 116° E.	N. 118° E.

The average course of the storm paths for 24 hours coincides very closely with the portion of the axis of the rain and for the preceding eight hours.

By dividing the paths of 79 storms into quadrants the following table of the prevailing winds was obtained:

N. quadrant.	S. quadrant.	E. quadrant.	W. quadrant.
7.6	8.8	8.3	10.1

By further comparisons of extremes of velocity of storms and prevailing winds, the following result was determined:

Velocity of storm in miles per hour.	Velocity of wind in E. quadrant.	Velocity of wind in W. quadrant.
32.1	8.8	9.0
18.1	7.8	11.3

These numbers show that the stronger the wind on the west side of the storm, the less is the velocity of the storm's progress. When the velocity in the east quadrant is equal to that in the west quadrant, the velocity of the storm is seven miles greater than the mean; but when the velocity of the wind in the west quadrant exceeds that in the east by 45 per cent, the velocity of the storm's progress is seven miles per hour less than the mean.

A comparison of barometric observations showed that when the barometer after a storm has passed rises 50 per cent more rapidly than usual, the storm-center advances 21 miles per hour more rapidly than the mean; but when the mercury afterward rises 50 per cent less than usual, the storm is one that has traveled 13 miles per hour less than the mean. The barometric pressure at the center of the storm does not afford an index to its progress. When the barometer rises rapidly as the storm passes by, the pressure at the center is increasing, but when at the rear of the storm the barometer rises slowly, the pressure at the center is diminishing or the storm is increasing in intensity. If the rise of the barometer is 22 per cent greater than usual, the central pressure increases one-tenth of an inch in 24 hours; if 22 per cent less than usual, the central pressure decreases a tenth of an inch in 24 hours. When the winds on the western quarter of a storm are stronger than those on the eastern, the storm is increasing in intensity; the reverse is true when the winds on the eastern quarter are strongest. But this rule is subject to numerous exceptions.

Prof. Loomis then explained the process by which he applied similar computations of the relative velocities of the winds, &c., at high altitudes, such as that of the Signal Service stations at Mount Washington; coming to the conclusion that at the hight of 6,000 feet in the western quadrant of a storm, the velocity of the wind is more than double that of the storm. By another series of computations he obtained the forms of the isobaric curves in at least 200 cases. In 55 per cent of the whole number of cases the major axis of the isobar exceeded its minor axis by half its length; in 30 per cent the major was double the minor; in 3 per cent the major axis was at least four times the minor. The storms of the United States are mostly of an oval form, with the longer axis most frequently in a direction about N. 40 E. About three-quarters of the great storms originate in the extreme West. In a case of which the details were particularly reviewed it seemed probable that the first development of magnitude in a storm began with the collision of moist air from the Pacific Ocean against the peaks of mountains in Oregon, resulting in heavy rainfall. But the most remarkable fact elicited was that the storm, once originated and organized, traveled over the highest mountain ranges without indicating sensible obstruction, proceeding eastward across the whole continent of North America.

LOWER SILURIAN FOSSILS.

BY PROF. J. S. NEWBERRY OF COLUMBIA COLLEGE, NEW-YORK.

This was a memoir on the so-called Land Plants of the Lower Silurian in Ohio. In the January number of *The American Journal of Science* Mr. Leo Lesquereux describes two fossils found in the upper

portion of the Cincinnati group, near Lebanon, Ohio. These he considers as the remains of land plants, and refers them to the genus *Sigillaria;* and this case is cited as the first instance where plants so highly organized have been met with in Lower Silurian rocks. Through the kindness of the Rev. H. Hertzer, to whom the specimens in question belong, they had been in my possession some time before the publication of Mr. Lesquereux's notice, and I had examined them with some care for the purpose of determining, if possible, their botanical relations. I had also made careful drawings of them, of which copies are herewith submitted. As the result of my examination I am compelled to say that I fail to find either in the external characters or internal structure of these specimens any satisfactory evidence that they represent land plants; still less that they form species of the genus *Sigillaria.* Their external markings are fairly represented in the accompanying figures, and I am compelled to say that they exhibit no internal organic structure whatever. They are simply casts in earthy limestone without carbonaceous matter, or any traces of woody tissue. The smaller specimen is a discoid section of a cylindrical trunk of which the external surface is very smooth, but is marked by a reticutation not unlike that of one section of the genus *Sigillaria.* I fail to find, however, any dots or tubercles in the centers of the meshes, such as are referred to by Mr. Lesquereux, and which were they present might be supposed to represent the place of the nutrient vessels of the leaves. Taken by itself I should say that this specimen might be considered to represent a sponge or some other low form of marine life, quite as well as *Sigillaria.* Since the specimen is so small and forms so little of the original organism I think it would be unsafe to make it the base of any general and important conclusion.

The layer specimen is represented, like the other, of the natural size. This is also a cast of a nearly cylindrical trunk of which the external surface is roughened by irregularly disposed and unequally sized lenticular prominences. These recall, in a rude way, the leaf scars borne by the trunks of some Lycopodiaceous or Cycadaceous plants, but they do not exhibit the spiral arrangement, nor the details of structure which the leaf-scars of such plants almost universally retain in the fossil state. In the interior of this trunk are seen a few irregularly scattered points of carbonaceous matter, but they are not continous fibers, and to my eye show no traces of cell structure.

Taking all the characters of these interesting fossils into consideration, I am disposed to regard them as casts of the stems of fucoids. Had they been land plants they would almost certainly exhibit more distinctness and regularity of surface marking, some coating of carbonaceous matter, and some traces of organic structure. A large number of specimens of sea-floated land plants, which we have found in the Devonian limestones of Ohio, all assert their botanical affinities by these characters. The remains of fucoids, on the contrary, consist almost universally of mere casts of their external surface, carbonaceous matter and internal structure having both entirely disappeared. For these reasons, therefore, I should hesitate to hang upon these specimens so important a conclusion as that promulgated by Mr. Lesquereux. I would not be understood, however, to assert positively that they are not the remains of land plants, for they are too imperfect to be decisive of that question, but only this, that they do not afford characters which permit one to accept them as evidence of the existence of land plants, and certainly not of *Sigillaria,* in Ohio, during the Lower Silurian age. The remains of what have been called land plants are found in the Lower Cambrian sandstones of Sweden, and two species have been described (*Eophyton Lennarsonum,* Torell, and *E. Torelli,* Lenarson). These plants are pronounced by algologists not to be algæ, but are referred to vascular cryptogams and monocotyledons. It is not certain, however, that they are not thallogens, as all traces of structure are lost, and nothing is left but the cast or impression of the external surface. (*Geological Magazine,* September, 1869.)

Land plants of Gaspè have also been found in the Upper Silurian strata, Canada, by Prof. Dawson. Here, with a large number of fucoids, a few specimens have been found, which he refers to his genus *Psiloplayton.* In these the scalariform axis, and the outer fibrous back both remain and serve as satisfactory guides in their classification. (*Dawson's Precarboniferous Plants of Canada,* p. 66.)

With these exceptions no land plants are reported below the Devonian. On this point, however, the evidence is all negative, and highly organized land plants may be at any time found in the Lower Silurian rocks. Indeed, the variety and high rank of the Devonian flora prepares us to expect such a result. Strict accuracy compels us to state, however, that up to the present time positive proof of the existence of land plants in the Lower Silurian has not been met with in other countries, nor is it furnished by the specimens under consideration. What we know of the physical condition of the region about Cincinnati during the Lower Silurian age strengthens the conclusion that the specimens before us are the remains of marine and not terrestrial vegetation. As I have shown in the Geological Report of Ohio, the Cincinnati axis was raised above the sea at the close of the Lower Silurian age, and when the Cincinnati group was deposited an open sea occupied all that region. The shores of this sea were formed by the Eozoic highlands about Lake Superior, in Canada, in the Adirondacks, and along the Blue Ridge; nowhere less than 500 miles away from the locality where these fossils were found. It becomes, therefore, extremely improbable that two distinct species of terrestrial plants should be wafted from those distant shores and deposited in the calcareous sediment of the sea at this point. The remains of fucoids are, however, not uncommon in the Cincinnati group, and the only objection to grouping these fossils with *Buthotrephis* and the other Silurian algæ must be found in their somewhat peculiar surface-markings. These are, however, not unlike the markings on the stems of many recent and fossil fucoids. The summit of the stem of the giant kelp *Macrocystis* is marked with irregular rings left by the removal of their great fronds, and the stems of many fossil fucoids are scaled or tuberculated more regularly and distinctly than are these specimens. Among such I will only cite *Arthrophycus Hallii* of the Medina, the tuberculated fucoid called *Halymenitis* of the Cretaceous, and the scaled *Phytoderma* of the Jurassic.

HOW THE EARTH WAS FORMED.

BY CAPT. C. E. DUTTON, U. S. A.

This paper was entitled A Criticism upon the Contractional Hypothesis.

The hypotheses that have been put forward to

explain the operation of forces beneath the earth's surface in producing its characteristic features are here referred to two types: (1) those attributing the surface features to contraction from loss of heat, which may be called the contractional hypothesis, and (2) the arguments which attribute them more or less to disturbances produced by external changes, which may be called the reactional hypothesis.

The contractional hypothesis assumes that the earth may be regarded as of two portions—a cooled exterior and a hot nucleus. The secular loss of heat is supposed to be greater from the latter than from the former, and by a consequent contraction of the nucleus it is assumed that the shell would tend to collapse. Owing to the unequal ability of certain portions of the shell to bear the tangential strains thus occasioned, the yielding taking place along the lines of least resistance would be manifested in the production of table lands, or mountains, or disturbed stratification. The smaller conductivity of materials underlying the land is held to account for the primary division into land and water, the land having been left behind in a general convergence of material toward the center.

There can be no reasonable doubt that the earth mass consists of a cooled exterior inclosing a hot nucleus, and secular cooling and contraction are necessary corollaries. As the process was of immense duration, we may take some starting point, and assuming the loss of temperature to have been continuous, may arrive at a period when the whole mass was fluid. As was pointed out by Sir William Thompson, this was a period of homogeneity, both as to material and heat. The first result of loss of heat would apparently be consolidation, and the argument of Hopkins is here accepted that consolidation would begin at the center, where pressure would enable congelation to be effected at high temperatures. Materials solidifying at the surface would sink by their increased density, until the surface was so far reached by solidification proceeding from the interior as to leave only an imperfectly liquid mass, where such movements, gradually retarded, at length ceased. The result would be a solid globe with perhaps isolated reservoirs of liquid that might consist of matter having a higher melting point.

MATHEMATICAL BASIS OF THE ARGUMENT.

Here follows in Capt. Dutton's memoir a summary of Fourier's solution of the problem of secular cooling. It is based upon certain factors, which are represented thus:

V, denotes half the difference of the two initial temperatures.
r, half their sum.
t, the time.
x, the distance of any point from the plane.
T, the temperature of the point x at the time t.
k, the conductivity of the material in terms of its own thermal capacity.

With these data a formula is computed. To obtain the coefficient of k, Messrs. Thompson and Forbes made experiments on rock material with thermometers imbedded at distances of from three to 25 feet during a period of 14 years. V, representing the maximum temperature of the interior of the earth at the beginning of cooling, must be hypothetical; for our purposes we may take it as the melting point of the more refractory material forming the chief bulk of the nucleus, and assume it to be that of the anhydrous silicates and that they are 500 to 800 miles in depth. Allowing for the effect of pressure upon the congealing point we may accept Sir William Thompson's estimate of this temperature as, at a maximum, 7,000° F. A course of mathematical reasoning then is put forward by Capt. Dutton, which shows that if it be possible to determine a true mean rate of increase of temperature per foot of descent at any point near the surface, the time required to elapse from the epoch of the establishment of the cooling to the present time can be deduced. This mean is placed by some investigators at 1-50 of a degree of Fahrenheit per foot, by others at 1-60; the former would give about 100,000,000, and the latter about 130,000,000 years.

The correctness of the mathematical deductions cannot be questioned, but the data on which they proceed are open to doubt. The coefficient of k may not be an invariable constant, as it seems probable from experiment that the conductivity of material increases as fluidity is approached. The time required to establish an increase which may be represented by 1° Fah., divided by 50.6, would thus probably be largely augmented. This would also reduce the basis of the contractional hypothesis by reducing the total dissipation of heat and the contraction inferred from it. Again, as to k, if porous rocks are saturated with water they are much worse conductors than those on which Sir William Thompson experimented; this value, now represented at 400, might then be put at 250. The effect of this would be to extend the duration of the cooling. Another factor open to question is the rate of increase of temperature per foot of descent. Its value, varying widely with locality, is found in some places one-fifteenth and in others one one-hundred-and-tenth. Proximity to igneous masses may vitiate any average based on such observations, as these cases may be extreme, and aqueous circulation below the surface may equally vitiate other observations.

RESULTS AS TO THE AGE OF THE EARTH.

(1.) Let us assume that the earth, when first ceasing to be fluid, had a temperature of 7,000° F., and now exhibits an increase of one one-hundredth of a degree for each foot of descent near the surface. The period between would then be about 625,000,000 years. At a depth of 300 miles the increase of temperature would be about a fifty-six hundred and fortieth of a degree per foot of descent; thence inward the total amount of cooling would be inconsiderable; outward it would augment at an increasing rate to the mean temperature at the surface.

(2.) Take the present surface rate of increase of temperature at, per foot, one degree Fah. divided by 50.6. The epoch would be about 160,000,000 years, and below 140 miles the rate of increase of heat would be inconsiderable.

(3.) Take the valuation of k at 400 instead of 250, and of the surface rate at 1 divided by 50.6, the epoch becomes about 98,000,000 years, and below 150 miles the rate of increase would be less than 1 divided by 2,700.

(4.) Take k at 250 and the surface rate at 1 divided by 200, the epoch would be 2,500,000,000 years, and at a depth of 600 miles the cooling might be disregarded.

But in general the application of this theorem is fatal to the contraction hypothesis, as it shows that after 200 or 300 miles the cooling has been comparatively little; were it otherwise the present rate of increase of heat per foot would be lower than the lowest reasonable estimate with our present knowledge. Our acquaintance with the laws of plutonic action is insufficient to take it into account, but as an element in the problem it may be regarded as of inconsiderable moment. Chemical changes could scarcely take place at the limits of sensible cooling, and cannot be regarded as operative at greater depths than 200 or 300 miles. The contraction of this portion cannot be more than one-tenth, if we assume the

total contraction of the earth's radius at 30 miles since the formation of a cooled exterior.

OBJECTIONS TO THE CONTRACTIONAL HYPOTHESIS.

By far the greater portion of this cooling must have taken place before the palæozoic age. By far the greater portion of the residue must have occurred before the beginning of the tertiary period, and yet the whole of this contraction would not account for the disturbances which have occurred since the close of the cretaceous period. To account for the tangential compression in mountainous regions we should be compelled to assume contraction since the Permian period. But we find the Laurentian rocks excessively disturbed, and cannot attribute this to secular contraction of the interior. Shrinkage of one-fifth in linear density implies an increase of 95 feet in mean density; and this is incompatible with any reasonable supposition as to the condition of the earth's mass while the Laurentian sediments were accumulating, if we consider their distortion as due to contraction.

Again, a vertical section through the Appalachian chain, and thence westward to the 100th meridian, shows a highly disturbed surface for 250 miles. If the contraction was general, there must have been a vast slip over the nucleus. But the friction and adhesion between the crust and the nucleus seem to have been overlooked. The analytical method applied to this would demonstrate its impossibility. Again, the tendency to corrugation along certain belts with series of parallel folds is assumed on a doubtful basis. The shrinkage of the nucleus would institute a strain in all directions within its own tangent plane. Relief by horizontal yielding in one direction would give no general relief; the intensity of the strain in all other directions would still remain. The case is not that of a collapsing cylinder, but of a dome, and great deformations of the earth's surface must ensue. The plications of the palæozoic rocks are not of this general character. They are localized in long and rather narrow belts. Still more discordant is the evidence of the tertiary plications; the disturbance from Cape Horn to Behring's Sea is a continuous, narrow belt. If we admit contraction along the belt alone, we cannot explain the regular figure of the earth as an ellipsoid of revolution with an eccentricity proportioned to its mean density and angular velocity. Here the analogy of the withered apple fails; if corrugated by shrinkage it fails to preserve its figure, or if preserving it, must corrugate uniformly. To avoid prolixity this argument is not carried into the discussion of details of surface.

Prof. Guyot read a memoir of Prof. James H. Coffin. The following papers were read by title only: A Memoir on the Zodiacal Light, by Prof. S. Alexander; On Some Points in Mallet's Theory of Vulcanicity, by Prof. E. W. Hilgard; The Polarization of the Zodiacal Light, by Prof. A. W. Wright.

Mr. James D. Warner of Brooklyn read a purely technical paper on a New Set of Bernoulli's Numbers, which are a mathematical invention for shortening certain algebraic processes by their application to the' coefficients of development of expanding series.

At the conclusion of this paper, without another word *pro* or *con*, without stilted resolutions, or any other of the numerous devices for closing an extended meeting, Prof. Henry simply rose from his chair and said:

"The Academy is now adjourned."

And it was adjourned.

ASSYRIAN RELICS.

PHOTOGRAPHIC COPIES AT WASHINGTON FROM THE BRITISH MUSEUM.

COPIES OF GEORGE SMITH'S RESTORED CHALDEAN TABLETS IN THE SMITHSONIAN INSTITUTION—HOW THE CUNEIFORM CHARACTERS WERE DECIPHERED AND THE STORY THEY TELL—THE RECORD OF THE EXPLOITS AND DECREES OF ANCIENT KINGS.

[FROM AN OCCASIONAL CORRESPONDENT OF THE TRIBUNE.]

WASHINGTON, D. C., April 24.—I make it a point to stroll over the Smithsonian Institution at least twice a month to see the additions to the curiosities which are there on exhibition. Last week my visit was rewarded by a view of the famous tablets which present the Chaldean account of the Deluge. These tablets are copies of those restored by George Smith, curator of the Assyrian and Oriental Departments of the British Museum, and were procured by Professor Henry, at the request of Professor Mason, of Columbia College, Washington. Professor Mason has for several years made a specialty of Oriental languages and history, and is said to be the only man in this country who can decipher the character of the cuneiform inscriptions. He was in the building at the time I visited it, and I found him in the great upper hall busily engaged in hanging the magnificent series of phototypes published by the British Museum, of which mention will be made further on. These copies will be placed in the large upper hall, which is to be devoted to ethnological subjects. All the natural history specimens which have hitherto been kept in that hall will be taken down stairs. New cases have been made for the proper exhibition of ethnological curiosities, and the vast collections of the Smithsonian illustrating the habits and life of North American Indian tribes, as well as of many other uncivilized peoples, including some that are prehistoric in their antiquity, will thus be brought together and arranged with accurate classification for the use of the professional student. The systematic method of arrangement of the collections of the Smithsonian Institute, under the care of Prof. Baird, adds materially to their usefulness and value.

Professor Mason soon became enthusiastically interested in the subject of the tablets, and gave the following history of their discovery and restoration:

Some twenty-five years since, Mr. George Smith, a young engraver in London, showed considerable interest in matters of Oriental art and curiosity deposited in the British Museum, and, finally, upon the return to England of Sir Henry Rawlinson, the distinguished Oriental scholar, astonished the latter one day by easily deciphering the inscription upon one of the Assyrian relics brought by Layard from Nineveh. Mr. Smith became an employé of the Museum, and ultimately curator of the department of Oriental antiquities. In 1846 Mr. Layard, while making his excavations on the supposed site of Nineveh, broke through into a large room, which proved subsequently to be the library of Assurbanipal, who was King of Assyria B. C. 668-640, and who established this library B. C. 667. The writings of the ancients were engraved upon tablets, which, in most instances, were made of stone; but, at the Euphrates's mouth, the area covered by the Chaldean Kingdom is entirely alluvial, and stone is altogether wanting; therefore, the Chaldean tablets are made of terra cotta, or else of unburnt clay. Layard found large numbers of these tablets,

arranged about the room in four divisions, lying in piles like blocks. These he collected carefully and sent to England; but during the transit home, owing to careless packing, nearly all were reduced to fragments.

THE STORY OF THE FLOOD.

Large numbers of these tablets comprised the grammar, lexicons, dictionaries, and spelling-books of the language, and one of the four divisions of the library was known as the Mythical and Mythological section. In this latter section Mr. Smith discovered the story of the Deluge, and in a paper read before the Biblical Archæological Society of London described as follows his patient labors in attaining its restoration and translation:

From the Mythical and Mythological section of Assyrian texts I obtained a number of tablets, giving a curious series of legends and including a copy of the story of the Flood. On discovering these documents, which were much mutilated, I searched over all the collections of fragments of inscriptions, consisting of several thousands of smaller pieces, and ultimately recovered 80 fragments of these legends, by the aid of which I was enabled to restore nearly all the text of the description of the Flood and considerable portions of the other legends. These tablets were originally at least 12 in number, forming one story or set of legends, the account of the Flood being on the eleventh tablet. Of the inscription describing the Flood, there are fragments of three copies containing the same text; these copies belong to the time of Assurbanipal, or about 660 years before the Christian era, and were found in the library of that monarch in the palace at Nineveh. The original text, according to the statements on the tablets, must have belonged to the City of Erech, and it appears to have been either written in or translated into the Semitic Babylonian at a very early period. The date when this document was first written or translated is at present very difficult to decide. * * * On comparing the Deluge text with dated texts of the time of Sargon I., it appears to be older than these, and its original composition cannot be placed later than the seventeenth century before the Christian era; while it may be much older

The eleventh tablet, which, as Mr. Smith has proved, contains the account of the Deluge, comprises two hundred and eighty-nine lines of cuneiform characters, inscribed upon both sides of the tablet. The copy sent to the Smithsonian is in two plates, showing each side of the original inscription, which are handsomely mounted to protect them from injury. Assurbanipal, in whose time the library was founded, is supposed to be the King who was known to the Greeks by the name "Sardanapalus," and who occupied the relation to Assyrian history that Pisistratus did to that of the Greeks. The study of the cuneiform characters has since 1802 been closely pursued by Oriental scholars, and the results attained in reading the inscriptions contained in the British Museum have been long foretold as describing the history of the Chaldeans and Assyrians.

FAC-SIMILE PUBLICATIONS BY THE BRITISH MUSEUM.

The British Museum has already published six volumes of the cuneiform texts in fac-simile, giving also the results, as far as ascertained, of the labors of various scholars in their translations. In addition to these, an enterprising London firm has published an extensive series of photograhs of objects in the Museum, and that portion which relates to Assyrian history has just been received at the Smithsonian, and is the collection already spoken of as being prepared by Prof. Mason for exhibition. A large portion of these photographs are of the sculptures in the North-West Palace at Nimrud, which is nearly opposite the supposed site of Nineveh, and are of three groups or periods, B. C. 884, B. C. 745, and B. C. 668, and afford to scholars tests of progression in the art at these three dates. The oldest sculptures discovered by Layard at this place, are of the time of Asshur-na-zir-pal, B. C. 884 to 850. The deeds of this monarch are related at length, and no details seem to have been considered too minute or insignificant to be depicted. The exploits of the King in hunting are as minutely finished as those describing his military expeditions. From these former slabs it appears that he "preserved" his game, having a large park stocked with wild animals, the supply of which was kept up by tribute and by presents. The King is represented riding down his enemies, bending his bow and shooting at their defenses, or receiving submission. All the details of slaughter, and of the cruel, barbarous treatment of prisoners are given—such as impalement on high poles, cutting and disembowelling—and show exactly the various arms, engines, and military implements of the time. The famous "Black Obelisk," found by Layard in the Central Palace at Nimrud, was erected in this palace by Shalmaneser II., and represents the incidents of thirty-one campaigns of that monarch, and among others receiving the embassador and tribute of Jehu, King of Israel. This occupies the top row of one of the four faces, and is the first mention in Assyrian history (B. C. about 850) of a Jewish king. The Assyrian series of plates closes with the reign of Assur-ban-i-pal, and these as works of art present the most advanced specimens. In the hunting scenes the sport is tamer as compared with like scenes in the reign of Asshur-na-zir-pal of 200 years before. The lions are now carried in cages to the spot and then let out, while in the earlier time the game was roused in the open country and hunted down. The very expression depicted upon the face of the game shows the decadence of the sport, and all accessories of the scenes depict a lazier and more ostentatious mode of hunting, and foretells the decay of the empire, which in less than 50 years (B. C. 500) crumbled to pieces. In one of the photographs is shown a small glass vase, found at Nineveh, bearing the name of the Assyrian monarch Sargon, the date of which places it in the year 719 before the Christian era. This is the earliest known specimen of transparent glass.

Many of the tablets bearing decrees of the King are trilingual, though merely variations of the Semitic writing. These inscriptions, being placed in parallel columns, long set at fault the efforts of scholars to decipher them, until it was discovered that the three great divisions of the Chaldean Empire were inhabited by people who varied in speaking and writing their language greatly, and the three columns contained these three variations.

THE POET LONGFELLOW.

LECTURE BY MR. JAMES T. FIELDS.

A DISCOURSE UPON HIS CHARACTER AND POETICAL WORKS—HIS GENIUS AND ZEAL FOR STUDY—INTERESTING DETAILS OF THE ORIGIN OF SOME OF HIS FAMOUS POEMS—HOW THE "PSALM OF LIFE" AND "EXCELSIOR" WERE WRITTEN—HIS TRIBUTES TO HIS FRIENDS—A DELINEATOR OF FINE AND TENDER SYMPATHIES.

[FROM AN OCCASIONAL CORRESPONDENT OF THE TRIBUNE.]

BOSTON, April 24.—The pupils of the Girls' High School have had another addition to the debt they already owe Mr. James T. Fields. He has always taken a great deal of interest in the school, and when he had prepared his interesting lecture on Tennyson, he first submitted it to their indulgent ears. The lecture on Longfellow, which he read to them on April 24, surpasses any of his previous essays of a similar nature in its admiring appreciation of his subject and intimate acquaintance with it. Its delivery may be considered as a sort of literary dress rehearsal, and, if the evident delight of the young ladies and the few score of visitors who heard it is any criterion of the favor with which it will be received by the general public, it will prove more successful than either of the half-dozen similar essays which have been so favorably received during the past Winter. The lecture, which is fully reported below, occupied in delivery hardly an hour.

THE LECTURE.

FELLOW-STUDENTS: I once had the pleasure of speaking to you in this hall on "Alfred Tennyson, the Poet Laureate of England." I am to speak to you now on one of our own stars who have sung, a poet of such marked and varied excellence, a character so reverenced and beloved among us, and indeed everywhere, that I have only to mention the name of Longfellow to secure at once your sympathy and your interest in my theme. It seems to me that this early hour of the day is the selectest one for reading an essay on Longfellow to such an audience as this; for he is always young, always full of the spirit of sunshine and the dawn, always imparting strength and courage to endeavor, and always singing in his own peculiar way that "life is real and earnest:" that we must all strive to "act in the living present," and that "still achieving, still pursuing," should be the end of our flying and fleeting existence. Somehow the world has always had an irreverent habit of elevating its nose at living authors of genius, as if it was a crime for a really great poet or prose writer to be alive and well and enjoying the society of his friends; as if dust and ashes added a certain respectability to merit, and it were highly appropriate to wait till a man be safely under the ground before he was to be considered an heir to fame and celebrated accordingly. As soon as a great author is dead, we all begin to do him justice. Then we crowd about his grave and throw in tributary flowers that should have made glad his heart and all his living senses while he still lived among us, and when he could have heard the voice of praise not with the dull, cold ear of death, and felt the laurels around his living, sensitive brow. Let us try, to-day, to be just to a living poet, and express without reserve that earnest pride we feel in him, and which those who will come after us will be sure to cherish.

THE GRAND AND HEALTHY LESSONS OF HIS POETRY.

The poetry of Longfellow is full of grand and healthy lessons. "Stand up to your work, whatever it may be, and do not be afraid of it," is one of them. We are sometimes unmindful here in America that corn must be ground before it is baked. We are apt to hurry everything, and to forget that if we do not know a thing correctly we really do not know it at all. But Longfellow is to be placed with the army of scholars as well as with the gifted band of world-renowned singers. I am to speak to you of a man whose poetry is not an experiment, but an assured and lasting fact; of one who has no infirmities which I have been able to discover; of one whose fancy never disordered or misdirected the purpose of his muse. Some poets, and good ones, have sometimes flamed out, vaguely bristling with dictionary words, and shocked us with their vagaries of thought and expression; but Longfellow is never false or affected; his language is always that of man to man and human heart to human heart. He never writes of one thing for the purpose of putting another. His purpose is always direct, and he goes to his work with the certainty of the arrow and with a power that is thoroughly in earnest. In the year 1820—just fifty-four years ago—the question was started in *The Edinburgh Review*, which raised such a breeze throughout America that the query is destined never to be forgotten. The exact form of the inquiry is precisely in these words: "In the four quarters of the globe, who reads an American book?" Now I don't think at that period this question was an impertinent one. We really had not much literature to show, as to quantity or quality either, in those days. Twelve months after that question was asked, a young lad had just entered his name as a student in Bowdoin College who was destined, forty years later, to become the most popular poet in the civilized world, including this same kingdom of Great Britain, where *The Edinburgh Review* was published.

MORE READ THAN ANY OTHER LIVING POET.

To-day there is no disputing the fact that Henry Longfellow is more read than any other living poet; that his books are more widely circulated and bring more copyright than any other written in English verse. There must be some reason for this popularity, among high and low; some sufficient cause for this lasting and firm regard for the man who at a very early age came singing out from the borders of Maine into the world of song. Early he says somewhere—and I wish you all to remember this—that "genius is only the infinite capacity of taking trouble." I often think of the infinite pains Longfellow took when a youth to become a scholar, ripe and mature. Starting off in a small brig, in the first year of his college life, he goes into Denmark and studies Danish, and obtains a knowledge of Icelandic, German and Dutch in the same way. He resolved to be not a mere king of shreds and patches, but a real master in the studies he

determined to conquer. Holmes speaks somewhere of one who "performs a little with the lead pencil." Little performances were not what Longfellow was after in life. Let me give you a glimpse of him as he appeared years ago, from that little book, "A Year in Spain," and which contains an excellent account of Mr. Longfellow, whom the writer met in his wanderings. He says:

My companion was just from college and full of the ardor excited by classical pursuits, with health unbroken and with a curiosity which had never yet been satisfied. He had sunny locks, a fresh complexion, clear blue eyes, and all the indications of a joyous temperament.

This is a true and interesting picture of the young scholar in his first travels into the grand old world of art and romance. There are those called poets who live in the sleepy hollows of thought, "where it is all the time afternoon." But Longfellow is not one of these. He has made himself controller of that high art called poetry by coming in contact at all points with the great interests of humanity. Having been kissed by the fairy queen of song in his cradle he henceforth became her living subject to do her noblest and best work.

HIS PROFOUND AND SPECIAL SCHOLARSHIP.

Some scholars never carry their understandings about with them, but leave them dozing on the library shelves. A mere scholarly man could not have written as Longfellow wrote. A man may be very expert in all the dead languages, but utterly unlearned in any living one. A quotation quoted from a quotation is not the most enlivening to the present race. This all-alive and sharply modernized world of ours has outgrown the dead-letter times, strange as it may seem perhaps in Oxford and Cambridge. Longfellow's scholarship is profound and special, but it never clogs for a moment the impetus of his nineteenth century genius. He can answer correctly more questions than almost any man of his time out of the pages of the past, but he never intrudes his wisdom into his poetry. It is there, very deep down, like the roots of things, but the garlands of song cover up and conceal the river of knowledge that is flowing beneath them. If he were not known as the great poet, he would certainly be recognized everywhere as a preëminent scholar and thinker. In poetry, we are apt to have many acquaintances but very few friends. With how many men and women are we on speaking terms in poetry, but how few we really love and cannot live without! Our supreme favorites in the poetic art you can easily catalogue, and Longfellow is one of them. There is never any coldness, never any unsympathetic relation between him and his readers. I dare say you all remember those beautiful dedicatory stanzas in the new volume, published in 1849, where he flows out in that deep, tender strain of salutation to all who have ever sent him messages of friendship founded on a perusal of his writings.

MORE WIDELY QUOTED THAN ANY POET SINCE POPE.

Since Pope, no poet has been more quoted than Longfellow. He has added to the stock of English letters and speech as many lines, couplets, and verses as any other of a hundred years. This is a sure test of poetic thought and inspiration. You must look to Shakespeare and a few other great ones for a larger currency of expression than our American Longfellow had. The mottoes on thousands of title-pages are from him; if you go to England, you will hear him cited in Parliament, in Westminster Hall, and in the cathedral; every pulpit admits him, for his thought is wide enough to embrace all creeds and all spiritualities in his hallowed and responsive verse. It is because he humanizes everything he touches, that his lyre has nothing alien to any soil. I have heard him quoted by an American monk with a cowl, and I have heard him sung by a band of humble worshipers in a camp-meeting among the hills of New-Hampshire. No heart but can receive him and find consolation in his melodies, and this is one reason why he is one of the most popular of all poets writing English. Some one seeing a copy of one of his books lying in a low drinking saloon has said, "This is indeed true fame." The poorest cottager, if he have any books at all, must be sure to have something that Longfellow wrote. Being overtaken in the country by night, I found lodging in a humble house, I was shown to a little room next the roof, and there the only book beside the Bible was his "Voices of the Night," and I was forced to repeat, "This is indeed true fame." No poet has ever paid tenderer tributes to his friends than Longfellow, and that is a good sign. When Hawthorne, his friend and fellow-student, was buried on that beautiful May day, in 1864, the heart of the poet seemed to be weeping in that tender requiem that followed almost immediately after the funeral procession of the great romancer. In the lines addressed to the River Charles there is a verse commemorating three friendships, one of which was Charles Sumner's. He sings in his own melodious way:

"More than this, thy name reminds me
Of three friends, all true and tried,
And that name like music binds me
Closer, closer, to thy side.
Friends, my soul with joy remembers,
How like covered flames they start,
When I fan the living embers
On the hearthstone of my heart."

HOW THE "PSALM OF LIFE" WAS WRITTEN.

It is always interesting to know under what circumstances a poet has framed an immortal poem or sonnet or song. As I happen to know something of the origin and birth of many of Longfellow's poems, let me divulge a few secrets in regard to them. The "Psalm of Life" came into existence on a bright Summer morning in July, 1838, in Cambridge, as the poet sat between two windows at the small table in the corner of his chamber. It was a voice from his inmost heart and he kept it some time in manuscript, unwilling to part with it. It expressed his own feelings at that time, when he was rallying from the depression of a deep affliction, and he hid the poem in his own heart for many months. He was accused of taking the famous verse, "Art is long and time is fleeting," from Bishop's poem, but I happen to know that was not in his mind, and that the thought came to him with as much freshness and originality as if nothing had been written before. "There is a reaper whose name is death" crystallized at once, without effort, in the poet's mind, and he wrote it rapidly down, with tears filling his eyes as he composed it. "The Light of the Stars" was composed as the poet looked out upon a calm and beautiful Summer evening, exactly suggestive of the poem. The moon, a little strip of silver, was just setting behind Mount Auburn, and Mars was blazing in the south. That fine ballad, "The Wreck of the Hesperus," was written in 1839. A violent storm had occurred the night before, and as the poet sat smoking his pipe about midnight by the fire, the wrecked Hesperus came sailing into his mind. He went to bed, but the poem had seized him, and he could not

sleep. He got up and wrote the celebrated verses. "The clock was striking three," he said, "when I finished the last stanza." It did not come into his mind by lines, but by whole stanzas, hardly causing him an effort, but flowing without let or hinderance.

THE ORIGIN OF "EXCELSIOR."

One of the best known of all Longfellow's shorter poems is "Excelsior." The word happened to catch his eye late one Autumn evening in 1841 on a torn piece of newspaper, and straightway his imagination took fire at it. Taking the first piece of paper at hand, which happened to be the back of a letter received that night from Charles Sumner, Longfellow crowded it with verses. As first written down, "Excelsior" differs from the perfected and published poem; but it shows in its original conception a rush and glow worthy the theme and author. On a summer afternoon in 1849, as he was riding on the beach, "The Skeleton in Armor" rose as out of the deep before him and would not be laid. The story of "Evangeline" was first suggested to Hawthorne by a friend who wished him to found a romance upon it. Hawthorne did not quite coincide with the idea, and handed the theme to Lonfellow, who saw at once all the essential qualities of a deep and tender idyl.

It is a delightful tribute to Longfellow's genius that all young people delight so in his poetry. They find in it a childlike simplicity as well as the essential quality of supreme interest. The child detects the imitation article quite as readily as the parent, and will pass the spurious lyre and accept the real one with a judgment that is marvelous. Old and young, the laborer and the professor, alike find occasion for the inspiring words of Longfellow which they cannot do without. Everywhere, anywhere, he is in most perfect and delightful keeping. The untaught grace of poetry, the power of infusing the author's mind into the heart of the reader is his, and this endears him to his readers, and will endear him to generations yet to come.

THE DETRACTIONS OF CRITICS.

One of the commonest and most unfounded charges against authorship in every age is plagiarism. Now nine times out of ten what is called plagiarism is parallelism. If I were an artist and could paint like William Hunt, I would make a picture which would stand for all times of Hercules telling his servant to show a fault-finding visitor out of the room. It is a great fault in anybody who cannot praise easily. Habitual fault-finding is an immoral trait in any character, and a lesson we all should learn is to find out good things in what we see. Longfellow has not escaped detraction any more than the rest. The vultures of criticism have hovered and pounced on his reputation after their usual manner, but no great harm has ever resulted from their attacks. Always master of himself and his theme, the poet has sailed away out of his detractors' sight and quietly let them rave. Longfellow now lives of course above the region where the envious critics delight to bark and bite. But some of us remember what dissatisfaction was called up when he published a new volume of his works. The rats of reputation went on gnawing at his laurels for years, though they proved to be powerless against true genius and artistic skill, and the true son of the muses went on from strength to strength, while these vermin died at last from inanition and neglect. One of his purblind critics said he had "really written some brilliant pieces by accident." "Accident, then," I said, "was never better employed. Let us vary our railroad casualties with some accidents of the Longfellow type." I hope they still show the little room down in Bowdoin College, for it was in that pleasant apartment that the young poet of 19 wrote many of his early poems. These were all published in 1825, during his last year in college, in a periodical called *The United States Literary Gazette*, the sapient editor of which advised him to give up poetry and buckle down to law. I am very glad that Longfellow did not take his advice.

THE FRIEND OF HIS RACE.

In estimating Longfellow, I see no reason for comparing him with anybody else. He is sufficient in his own department, and has his own power and influence. Tennyson is Tennyson, Wordsworth is Wordsworth, Longfellow is Longfellow. He may not be this or that, but a writer should not be judged by what he is not. What he is should be the real question. Negations are not answers, but qualities in possession are what will determine cotemporary judgment as well as the judgment of posterity. What a procession of youth and beauty wander in perennial loveliness through Longfellow's pages. It can never grow old or fade away.

If I were called upon suddenly to prove that Longfellow is preëminently a poet in every sense, in imagination, in artistic skill, in all the equipment of a high-born singer, I think I should be willing to select from his later pieces the exquisite poem of Sandalphon, which if you wish, I will read to you. [Mr. Fields here read the poem.]

No English poet-scholar has ever made such masterly translations as Longfellow. Dante, as rendered by him, can be read now in the very spirit of the great Italian poet. Now, just what I claim for Longfellow is this: A high and honorable place in the poetic and prose literature of this century; a rank with the great spirits that still rule us from their urns; a name that can never die out of the annals of English literature and song; for I find in him those priceless qualities of excellence which the world, having once witnessed, never forgets. Longfellow goes in a straight line to his reader's understanding. The highway to the human heart is the one he most travels. His verse gives no translation to his reader. He is never a satirist, never a trifler, never a scorner, but a delineator of fine and tender sympathies, which makes him the friend of his race.

It was never truer than now that poetry has its own exceeding great reward. And let us never forget, my friends, when we are estimating poetry, what Longfellow himself teaches in one of his best and noblest efforts, that—

> "God sent his singers on the earth,
> With songs of sadness and of mirth
> That they might teach the heart of men,
> And bring them back to heaven again."

THE HORSE IN AMERICA.

PROF. MARSH'S DISCOVERIES IN FOSSILS.

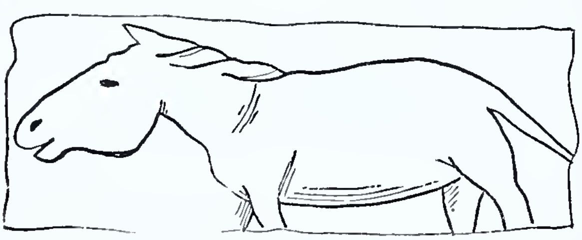
ANCESTRY OF THE NOBLE ANIMAL—THE MORMON BIBLE CONCERNING HORSES—SKETCHES BY PREHISTORIC MAN—THE FAMILY TREE OF THE HORSE.

[FROM THE SPECIAL CORRESPONDENT OF THE TRIBUNE.]

NEW-HAVEN, April 18.—Few facts in the history of the race have been the occasion of wider generalizations than the circumstance that the horse—the most important of all the animals which man has pressed into his service—was utterly unknown on the continent of America at the time of the discoveries of Columbus. Not only the horse, but all the related family—the ass, the zebra, and the quagga—were equally wanting. The Western hemisphere, in this total deficiency of both its divisions, presents a marked contrast to the Old World, since Europe, Asia, and Africa are each the native habitat of one or more members of this large family.

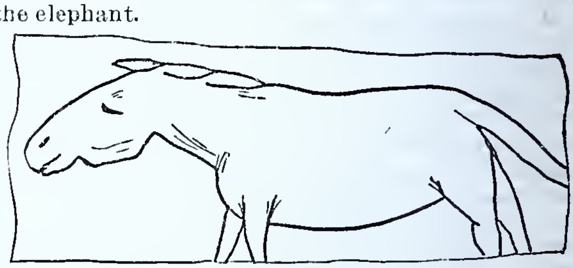
But the recent labors of science have opened a new page in the horse's history, and have changed entirely the scope and nature of the inquiry. It is now known that in the eras with which geology deals, America was not only for countless ages the home of the horse, but of an immense variety of animals of the horse family or nearly allied to it; and in the long series of these varying forms there seems to be presented evidence of change, progress, and development, which is welcomed by the believers in the theory of evolution as supplying many of the missing links in the ancestry of the noble animal.

Foremost among the laborers in this special field of research is Prof. O. C. Marsh of Yale College. Readers of THE TRIBUNE have had descriptions of his explorations at the West, and it will be only necessary here to summarize them in a few words. Almost every Summer for some years past he has organized an exploring party, chiefly at his own expense, in quest of fossil animal remains in the tertiary formation in our Western Territories. He has met with unexampled success. A greater addition of new fossil animal forms has been made since this class of explorations was undertaken, than during any similar period since Cuvier described the extinct animals of the Paris basin. A few of the extraordinary creatures which Prof. Marsh has identified, have been partially described in THE TRIBUNE. His expedition last Summer was peculiarly rich in discoveries of fossils of the horse family. It is to these the present letter relates.



SKETCH OF A HORSE BY PREHISTORIC MAN.

Did the horse exist in America after the advent of man, and become extinct between that period and the date of the discovery of America? This is a question of more interest than would be at first supposed. The horse of Europe was probably cotemporary with the earliest man, and there are traces of the existence of that animal among some of the most ancient relics of the cave-dwellers. In the cavern of La Madelaine, Dordogne, France, among remains of pre-historic man of the flint period, the antler of a reindeer was found having seven figures of horses carved upon it. Coarsely executed though they are, there can be no question as to what these flint carvings were intended to represent. These are horses—not asses, nor of the ass family, since the ears are short, none of the tails are tufted, and one of the tails certainly indicates by its thickness that it had the abundant long hair covering it which distinguishes the horse. It is not at all likely that the cave-dwelling man held the horse in subjection; it was probably one of the animals which he hunted; a kind of venison among game which included the auroch and the cave bear, the reindeer, and perhaps the elephant.

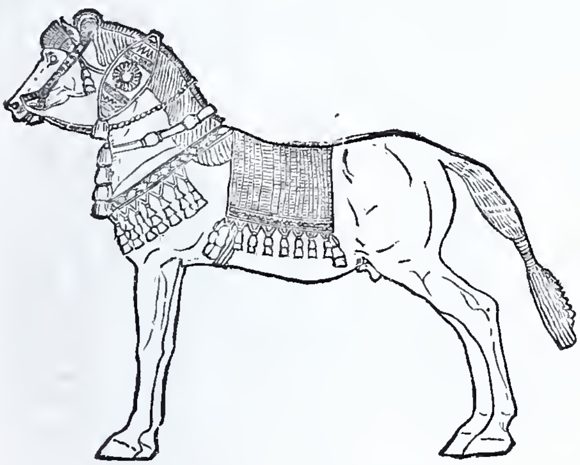


ANOTHER PREHISTORIC SKETCH.

But Brigham Young has hailed the discovery of fossil horses in America as an evidence of the truthfulness of the sacred writings of the Mormons. Years ago, in a discussion in England, the representative of the Mormons was worsted in argument upon the point that these writings make the blunder of describing horses as existing in America coeval with man, but prior to the advent of the Spaniards. There may be other instances in the Mormon Bible, but the following will serve to illustrate the point: The book of Ether describes a period subsequent to the building of the tower of Babel. It gives the particulars of construction, under divine command, of a number of covered barges, "exceeding tight," that would "hold water like a dish," each provided with an air-hole in the top, closed with a stopper, to be opened when needful for ventilation. These remarkable vessels were loaded with provisions; a small colony embarked upon them, and a strong wind, miraculously provided, drove them across the ocean. The voyagers were 344 days afloat, without light or fire; but at last they reached the promised land, where, it is stated:

> In the space of sixty-and-two years they became exceeding rich, having all manner of fruit and of grain, and of silks, and of fine linen, and of gold and of silver, and of precious things, and also all manner of cattle, of oxen, and of cows, and of sheep, and of swine, and of goats; * * * and they also had horses and asses, and there were elephants, and cureloms, and cumoms; all of which were useful unto man, and more especially the elephants, and cureloms, and cumoms.

Now there is not a trace of the horse among the antiquities of the Indian tribes on this continent. Not a legend, not a fragment to mark its coexistence with man, in all the records that have been compiled, in all the mounds that havo been opened—unless the two following incidents be accepted as evidence to the contrary: (1) Dr. P. W. Lund was the first discoverer of fossil bones of the horse in South America. He found in 1841, in a cave in Brazil, among other remains of animals, the greater part of the skeleton of a young horse which he described as *Equus neogeus*, and declared to be identical with a specimen found in a another cave associated with human bones. But Owen says, after critically reviewing this case, that it affords no evidence of the contemporaneity of the human and equine races in the Brazilian caves. (2) Prof. Marsh has in his possession a bone picked up by an explorer among the ruins of one of the deserted cities of Central America; it is the coronary bone of a horse; *i. e.*, the first bone above the hoof. There is no doubt of the antiquity of the ruined city; as to that of the coronary bone the reader may form his own judgment.

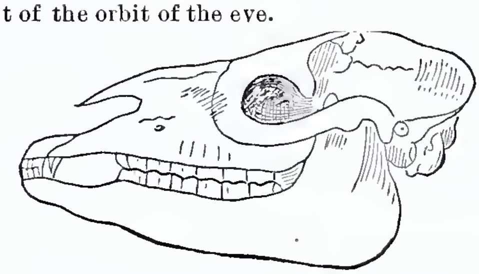


AN ASSYRIAN HORSE.

The omission of all attempts at depicting the horse or any member of the horse family on the part of the American aborigines, if it were known to them, is very remarkable. The earlier sculptures of the old world frequently introduce the horse; on the remains of Nubian tombs and Egyptian temples we find this animal carved. An Assyrian horse among the bas reliefs of Ashurbanipal is not less remarkable for the elaborate trappings of his harness than for his own noble bearing. He is every inch a horse. Surely such an animal would have left some traces in Indian tradition; but we read that "When the Cherokees first saw the horse bestrode by De Soto they were as much amazed as were the soldiers of Fabricius when they first beheld the elephants of Pyrrhus. But they named it instantly 'the animal with a single finger-nail. Modern science has made no better generalization than this uniungulus." This is the distinctive feature of the race; equally true of the horse (*Equus caballus*), of the tame ass (*Asinus vulgaris*), of the wild ass (*A. onager*) still abundant in Mesopotamia, and almost as different from the domestic species as a greyhound from a poodle, of the zebra (*A. zebra*) of South African mountains, the quagga (*A. quagga*) and the peetsi (*A. burchellii*), both also of South Africa, and of the kiang (*A. hemionus*) of Thibet. If you claim tho transformation of species, said Cuvier in the early days of the development hypothesis, you must produce, for instance, between the paleotherium and the horse, since the former has three toes and the horse only one, an animal similar to each in other respects, but having the intermediate number of toes. It is precisely this gage, thrown down so confidently by Cuvier a half century ago, that tho palæontologist of to-day is prepared to take up: but the present evidence is far more extended in its scope than that which the Father of Palæontology doemed unobtainable.

There is a vast portion of the Territories of Wyoming and Utah, which in the period that geologists call the tertiary, contained enormous lakes. The oldest of these lakes remained so long in eocene times, that the mud and sand accumulated in it by slow deposits to more than a mile in vertical thickness. In these deposits Prof. Marsh has found the remains of the Orohippus. This animal's skeleton resembles that of the horse more than it does that of any other creature of the present day; but it was scarcely larger than a fox. Its skull was proportionally shorter than that of the horse, and the orbit of the eye was not inclosed behind by a bridge of bone. But the remarkable characteristic of the Orohippus was that his fore feet had four toes and his hind feet three toes, all of which reached the ground.

Above the eocene, in the order of geological deposit, many centuries doubtless having elapsed in its formation, the miocene appears. A district known as the Bad Lands of Dakota, Nebraska, and Colorado, and another west of the Blue Mountains in Eastern Oregon, contain deposits of lakes that existed in the miocene period. In the latter of these localities Prof. Marsh has obtained the remains of the Miohippus. It resembles the Orohippus in several particulars, but had this noteworthy peculiarity—it had only three toes in the fore feet as well as behind. All these toes reached the ground, and were useful, or, at all events, usable. There is no depression in front of the orbit of the eye.

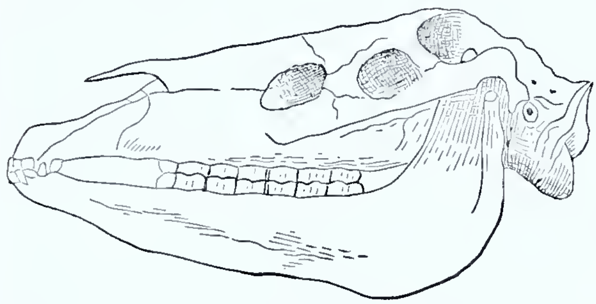


SKULL OF THE ANCHITHERIUM.

In these miocene lake deposits another animal is found, closely allied to Miohippus, but differing in having a deep depresssion in the skull in front of the orbit. Prof. Marsh has discovered some and Prof. Leidy other species of this animal, which is

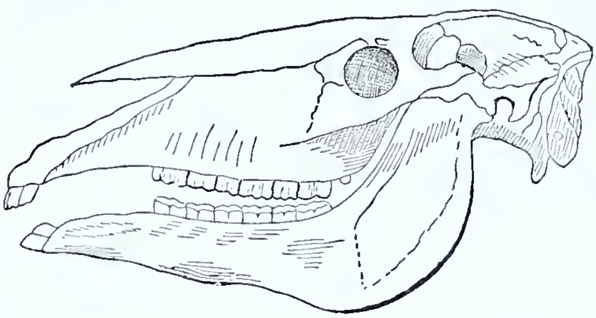
called the Anchitherium. It had three toes on each fore foot and three on each hind foot; but its outer toes were proportionally smaller than those of the Miohippus. The Anchitherium and the Miohippus were about the size of a sheep.

Above the miocene formation is the pliocene. Again ages have elapsed while this deposit was forming, and here again we have animals of the horse kind. Let us select two of them for examination, the Hipparion and the Protohippus. Each has three toes before and three behind, but in no case do the outer toes touch the ground; they are like the posterior hooflets of the modern deer and ox. The serviceable hoof of each is stouter than in the preceding animals. The skull of each has a deep depression in front of the eye.



SKULL OF THE HIPPARION.

In the Pliocene we also find the Pliohippus—or at least Prof. Marsh does. It has a deep depression under the eye. It and the Hipparion about equal the ass in hight. The Pliohippus has but one toe—that is, its foot is like the modern horse.



SKULL OF THE MODERN HORSE.

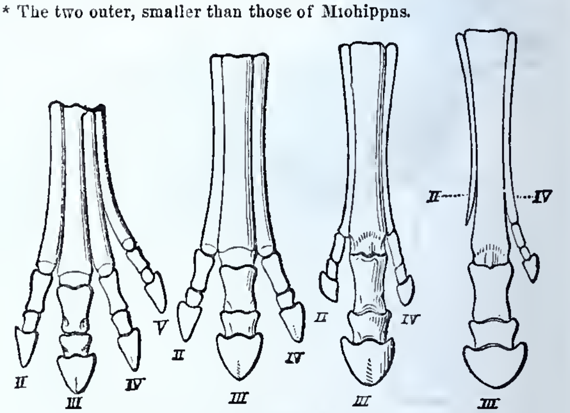
Lastly, at the very top of the pliocene formation and just where it is passing into the quaternary, for the first time the bones of the true horse are found. It equaled in size the horse of the present day, and in some species surpassed it. The existing horse has no depression in front of the orbit. Occasionally it has a superfluous hoof hanging about the true one.

There are many other facts of a similar character about these skeletons and those of other cognate forms, all indicative of a series, of progression, or as the believers in that theory would call it, of development. In respect to the toes the argument may be briefly stated thus: The single-toed hoof represents the highest capacity for speed; four toes might be useful for support in the marshes, but the necessity for speed would sooner or later make animals with fewer superfluous toes take precedence of the others. The reduction in the number of toes may in this manner be due to the gradual elevation and drying of the region inhabited. The struggle for existence of the early horse was principally in successfully running away from beasts of prey. Also, the hoof is a weapon of offense. At the present day, if a horse wounded or a mare embarrassed with colt, is overtaken by prairie wolves, the hoof is used to great advantage, each kick that strikes a wolf squarely usually killing it. Nothing could be more inconvenient than superfluous toes in kicking. But what is to be done with the depression in front of the eye? This was developed without apparent reason and disappeared equally without reason. Ah, there are some things, perhaps, which even the development hypothesis cannot explain.

Let us tabulate our facts:

Geological deposit.	*Name of animal.*	*Comparative size.*	*Depression in front of the eye.*	*Number of toes to foot.*	*Toes that touch the ground.*
eocene	orohippus	fox	none	4 front, 3 hind	all
miocene	miohippus	sheep	none	3 each	all
miocene	anchitherium	sheep	deep	3 each*	all
pliocene	hipparion	ass	deep	3 each	1 each
pliocene	pliohippus	ass	very deep	1 each	1 each
quaternary	equus	horse	none	1 each	1 each

* The two outer, smaller than those of Miohippus.



MODIFICATION OF THE HOOF.

(1) Forefoot of the Orohippus. (2) Foot of the Miohippus. (3) Foot of the Hipparion. (4) Foot of the modern horse as occasionally seen, with superfluous hooflet.

It will be seen that there are yet more worlds to conquer. Prof. Marsh lives in the hope of seeing the skeleton of the predecessor of the Orohippus; say with four toes behind and five in front. And having got that equine ancestor, he will not be satisfied till, somewhere at the bottom of the eocene, or even back in the cretaceous deposits, he finds the greatest-great-grandfather of all the horses, which should be about the size of a first-class black-and-tan, and should have five well-defined toes on each foot, touching the ground. With this fossil in his possession, Prof. Marsh would probably be able to enjoy life without going to the Rocky Mountains every Summer.

HAVE WE TWO BRAINS?

A LECTURE BY DR. BROWN-SEQUARD.

INSTANCES WHERE PATIENTS USED ONE HALF THE BRAIN INDEPENDENTLY OF THE OTHER — THE LEFT BRAIN PRINCIPALLY THE ORGAN OF INTELLIGENCE AND EXTERIOR RELATION; THE RIGHT, OF ORGANIC FUNCTIONS AND NUTRITION—THE NEED AND MEANS OF DEVELOPING BOTH SIDES OF THE BRAIN.

[FROM A SPECIAL CORRESPONDENT OF THE TRIBUNE.]

WASHINGTON, April 22.—The lecture delivered at this date by Dr. Brown-Séquard, which attracted a crowded audience, was one of the "Toner Lectures." As many readers may not recall the circumstances under which that course of lectures was established, a statement of the facts will probably be of interest. Dr. J. M. Toner, believing that the advancement of science—that is, a knowledge of the laws of Nature in any part of her domain, and particularly such discoveries as contribute to the advancement of medicine—tends to ameliorate the condition of mankind, determined in 1872 to convey real and personal property worth about $3,000 to five trustees; 90 per cent of the interest of which was to be applied for at least two annual memoirs or essays by different individuals, and, as the fund increases, as many more as the interest of the trust and revenue will, in the judgment of the trustees, justify. The essays or memoirs must be relative to some branch of medical science, and be read in the City of Washington under the name of the Toner Lectures. Each of these memoirs or lectures is to contain some new truth fully established by experiment or observation, and no such memoir or lecture is to be given to the world under the name of the "Toner Lectures" without having first been critically examined and approved by competent persons selected by the trustees for that purpose. The trustees are the Secretary or chief scientific officer of the Smithsonian Institution (for the time being, Prof. Joseph Henry), the Surgeon-General of the United States Army, the Surgeon-General of the United States Navy, and the President of the Medical Society of the District of Columbia.

THE LECTURE.

LADIES AND GENTLEMEN: I have to-day to put forward views which, if they have the value that I attach to them, deserve all your attention. I confess, however, that although I have come to a conviction myself, and I am, perhaps, rather difficult in that respect, I do not accept easily as proved what is drawn from facts. I confess, however, that I feel great embarrassment, as not only are the facts I have to dwell upon new, and not, perhaps, easily to be accepted, but besides they require for their full understanding a knowledge of medicine, which probably does not exist among many of my hearers. However, I will try my best to render the subject as clear as possible, even to persons who know nothing about medicine.

EVIDENCE THAT WE HAVE TWO BRAINS.

As you perhaps know, the subject is this, putting it in an interrogative way, Have we two brains or one? And if we have two brains why do we not educate both of them?

As you will see by these questions, if the first is decided negatively, of course there is no reason for the lecture. The very fact, therefore, that I am in your presence to speak about an hour on that subject, implies that I have come to the conclusion that we have two brains, perfectly distinct the one from the other. There are views held in science in that respect altogether different from mine. They consist in admitting that the left side of the brain is the only organ serving to the movement and feeling of the right side of the body, and *vice versa*, the right side of the brain is admitted to be the only organ serving to volition and to sensation for the left side of the body. This view I will have first to disprove.

Beginning, however, by what relates to the noblest functions of the brain—that is its aptitude to serve in mental phenomena—I shall say at once that I am not the first to put forward the view that we have two brains. Long ago Sir Henry Olan, who died some time ago, and Dr. Wigan, and a few others, insisted on the fact that each side of the brain is perfectly sufficient for the full performance of the mental functions. But they stopped there, and they have left to others, therefore, to go further, if we have to go further. I shall say that, taking that view, that in reality we have two brains, there is a conclusion which flows out from it, and which —although I shall have to speak of it more at length by and by—I must now say a few words upon. It is quite certain that if it is so, as we make use of only one for most of our actions, we leave aside one-half of the total mass of brain matter, and, therefore, we leave quite useless one-half of the most important of our organs as regards manifestations of intelligence, will, and perception of sensation. If this statement is right you will easily understand how important it is to come to the point which I have in view in this lecture: that is that we ought to give education to the two sides of the brain, or, rather, to the two brains.

As regards intelligence, it is hardly necessary to insist after what has been said by the physiologists I have named, Sir Henry Olan and Dr. Wigan. They both showed that there are a great many facts which conclusively prove that either half of the brain may serve equally intellectual functions. It may be, however, that their proofs were not sufficient. One of the two, Dr. Wigan, has insisted upon a feature of great interest, which is that in insanity sometimes, and I may say very frequently without any insanity, we have two different views on the same subject. There are a great many people who labor through life under the difficulty of making up their minds. It is because they have two minds unfortunately. Better would it be for them to have only one, and I hope you will not conclude at once that what I am to preach here—that is, that we are to educate our two brains—ought to be laid aside on account of the danger of leading men to have two minds, and to be all the time hesitating between two views and two conclusions and two opinions and two decisions. I think I shall be able to prove that the fault in those individuals who cannot make up their mind is, on the contrary, dependent in a measure on the fact that they have not developed sufficiently the power of their two brains.

INSTANCES OF THE SEPARATE USE OF THE HALVES OF THE BRAIN.

Anyhow, Dr. Wigan especially insisted upon those facts which we observe in insanity, that a patient knows he is insane; he knows that he has insane ideas; he will

put them forward and immediately after having put them forward he will say: "I know they are insane." He is perfectly right, perfectly rational, while at the same time he is completely insane. Dr. Wigan has concluded, without any positive demonstratien, that in those eases one-half of the brain is normal and the other half is wrong; one-half is employed in the mental faculties in a normal way; tho other is employed as regards the mental faculties in quite a wrong way. But there are cases which are more interesting, perhaps, and which. I think, fall moro clearly under that view, that there are two brains. I saw a boy, for instance, at Nottioghill, in London, once, who had two mental lives. In the course of the day, generally at the samo time but not constantly, his head was seen to fall suddenly. He remained erect, however, if he was standing, or if sitting he remained in his position; if talking he stopped talking for a while; if making a movement ho stopped moving for a while, and after one or two minutes of that state of falling forward or drooping of the head—and he appeared as if falling asleep suddenly, his eyes closing—immediately after that his head started up, he opened his eyes perfectly bright, looking quite awake and theu asking if there was anybody in the room whom he had not seen previously, who the person was, and why he was not introduced to him; being all the time in that state quite different from the state of wakefulness. He had seen me a great many times, and knew me very well. Being with him once when one of those attacks occurred, he lifted his head and asked his mother, "Who is the gentleman? Why don't you introduce him to me?" His mother introduced me to him. He did net know me at all. He shook hands with me, and then I had a conversation with him as a physician may have with a patient. In another instance, when with him again, when he had the same kind of an attack, I found that he recognized me fully, and talked of what we had spoken of in our first interview. I ascertained from what I witnessed in those two instances, and also and chiefly, I may say, from his mother, a very intelligent womau, that he had two lives in reality, twe mental lives, one in his ordinary state, and another occurring after that attack of a kind of sleep for about a minute or two, when he knew nothing of what existed in his other life—in his ordinary life; that was all a blank. He knew nothing during that second state but what had occurred in previous periods of that same condition, but he knew full well all that had occurred then, and his recollection of everything was as perfect then as it was during his ordinary life concerning the ordinary acts of his life. He had, therefore, as I have said already, two absolutely distinct lives, in each of which he knew everything that belonged to the wakeful period of that life, and in neither of which did he know anything of what had occurred in the other. He remained in that state of attack for a time which was extremely variable, between one and three or four hours, and after that he fell asleep, and got out of that state of mind pretty much in the same way that he had got into it. I have seeo three other cases of that kind, and as so many have fallen under the eyes of one single medical practitioner, such cases cannot be extremely rare.

SPEECH NOT ALTOGETHER DEPENDENT ON ONE SIDE OF THE BRAIN.

As regards the faculty of speech, the fact that we have two brains perfectly distinct, one from the other, is not, perhaps, so easily proved as it may be as regards the man. We well know that a lesion in one-half of the brain, the left side of the brain, will produce loss of the faculty of expressing the ideas by speech; that that belongs almost exclusively to the left side of the brain, but the very fact, I may say, that the less of the faculty of expressing ideas by speech depends on a disease in the left side of the brain—that fact is itself a proof that the left side of the brain is quite distioet from the right side of tho brain, that it is in fact a brain in itself as regards that functiou of tho organ we call. brain. Therefore the fact which is perfectly well knowo, that out of one hundred cases in which the loss of the faculty of expressing ideas by speech existed, thero is only one—if one—in which the disease was to be fouud in the right side of the brain—that fact is extremely important in showing that tho two sides of the brain may act independently one from the other. I shall have to return to this by and by, as much of my argument depends on this peint.

As regards sight, a theory has been put forward by a celebrated philosopher, Dr. Wollasten of Lendon, which has beeu admitted by a great many physiologists, although no one has admitted it without some reluctance. But as there was no better theory put forward, that one was received as being at least probable if not demonstrated. Wollaston had the view that the right side of the base of the brain is the center for sight in the two right halves of the eye. The right half of the right eye is of course the one to the right of it, and the right half of the left eye is the oue nearest to the nose. The inner half I should say of the left eye and the outer half of the right eye have for their center, according to that view, the right side of the brain and *vice versa* the left side of the brain would be the center for sight in the left or outer half of the left eye and the inner half of the right eye. There is therefore, according to that view, a condition which is quite peculiar. If we admit it for a moment then we ought to find that a disease in the left of the brain at the base must destroy only one half of the power of sight, and objects then if seen are seen in one half. Suppese a man to be looked at there would be visible, if it is the left side of the brain which is affected, only the right half of the body. Wollaston himself had that trouble. One day trying to read the name of an instrument, the barometer, he read "meter" only; the other part of the word, "baro," he could not read. Another emiuent friend living in France, Professor Agassiz, had the same trouble. He saw oue half of certain objects. And a good many patients who are affected especially with certain disorders of movement and with diabetes have also that trouble, they see but one half of objects. There are, therefore, cases which seem to be in favor of the view. But continuing to review what ought to take place, we find that if the disease exists only in a small part of the left side of the brain, in that portion which serves to sight, we ought to find that then only one half of one eye will be affected. There are such cases. If it is the other part of that same half of the base of tho brain which is affected, then it is only one half in the other eye which should be affected. There are also facts of that kind.

So that there are three kinds of facts which seem to support the view of Wollaston. But what of that? We philosophers do not accept conclusions because there are facts which support them. We accept conclusions when all the known facts are either in perfect harmony

or clearly prove the conclusion; and also when there is no fact that seems to be in opposition. It is requisite, therefore, either that all the facts prove in favor of the theory, or that together with a number in favor there is none at all in opposition. Such is not the case here. There are a great many facts which show that a disease in one half of the brain will produce complete loss of sight of the two halves of one eye, either on the same side or on the opposite side, or the two halves of both eyes. Therefore there are three series of facts, and one only would be enough, which demonstrate that the theory ought to be rejected.

VISION AND THE HALVES OF THE BRAIN.

But as regards sight we find this, and it is a point of importance in this lecture. We find that a disease anywhere in one-half of the brain can exist without any alteration of sight at all. A disease existing in that part where the optic nerve goes into the brain, destroying that part altogether, may not be a cause of loss of sight; so that one optic track alone may be perfectly sufficient for the functions of the two eyes. Therefore I conclude that it is quite enough to have one brain to have our power of sight; and as it is so for each half of the brain, I can conclude—and this is a point of importance in this lecture—I can conclude that each half of the brain is independent of the other and each of them possesses the powers of serving to the sensations of sight. You will ask how is it that a disease in certain cases in the brain will produce loss of sight, and that a disease in the same part sometimes will not produce loss of sight. As regards that I cannot develop at length what I would have to say, but if some of you were present at my lecture in this city last year and some of you present at the Academy of Sciences to-day are here, they know that an alteration in any part of the nervous system, whether in the brain or elsewhere, can, by producing an irritation, act on other parts, so as to produce the loss of a function of those other parts: and so it is about sight particularly. In many experiments I have ascertained that injuring a small part of the spinal cord produces a loss of sight in the eye on the same side. An injury to the *medulla oblongata* a little higher than the part of the spinal cord which produces loss of sight on the same side, will produce a loss of sight, but to the opposite eye. There is, therefore, a power of producing by irritation a loss of sight; and indeed there is nothing more common in children having worms in their bowels than a diminution in the power of sight for a time, or some trouble in the power of sight—some change in the iris, some change in the vessels of the eye, in fact some disorder in the organs serving to vision. Well, it is in the same way that an irritation existing in certain parts of the brain will produce at a distance from the place where it exists, a loss of the function of sight. The cases that can serve are, therefore, not those in which we find that the disease exists—the loss of sight exists when there is a disease somewhere. The cases that can serve positively must clearly bring us to a conclusion; as those, on the contrary, which establish that an injury in any part or one-half of the brain—even in that part which receives the optic track—can exist without producing any loss of sight; and that fact has been observed—not very frequently, but more than five or six times to my knowledge—and in those cases in the most decisive manner. Therefore the conclusion I have drawn is quite established. Either half of the brain may serve to the power of sight.

THE VOLUNTARY MOVEMENTS.

Now, as regards the volitional movements, the voluntary movements, if you like to call them so. Those movements, as you well know, have been considered as depending on each half of the brain for one-half of the body. Still, many physiologists have ascertained that there are muscles in our system in the neck, in the eye, in the throat, and in the back also—there are many muscles—which escape paralysis when there is disease in one-half of the brain; and for those parts at least some theory has been imagined to try to explain how it was that the left half of the brain, for instance, is not the regulator of the movements in the right side of the body. I shall pass over that theory and come to the point of importance in the object which I have in view.

As regards volitional movements, there are cases on record which leave no doubt that either the anterior lobe of the brain, the middle lobe of the brain, or the posterior lobe, the three essential parts of the organ, can be destroyed and voluntary movements not be interfered with at all; but still more, there are cases—not many, but a few—that exist and are decisive. They have been recorded by the most accurate observers, and some of them in hospitals where there were many medical men and many students, so that there cannot be a doubt about them. There are many cases—perhaps the word "many" is too strong, but there are at least seven or eight to my knowledge—of the destruction of the whole half of the brain without any interference with the voluntary movement. Therefore we are not to look upon one-half of the brain as being necessarily the organ serving to the movement of the body on the opposite side. And also another conclusion; we are to look upon one-half of the brain, in some individuals at least, as being able to control voluntary movements in the two sides of the body. If so, certainly the point I have in view—that is, that we have two brains—is established as regards voluntary movements. We have certainly two brains as regards voluntary movements; and if it is found in most cases that even a slight injury limited to a small part of the brain will produce a paralysis on the opposite side, or sometimes on the corresponding side—if that is found, it is on account of this principle which I mentioned a moment ago; that is, that an irritation in any part of the brain can affect functions in other parts through irritation. And I shall say about voluntary movements what I have said about sight, and a worm in the bowels, as well as an irritation in a tooth, or an irritation in the stomach, an irritation in the lungs, an irritation in the heart, an irritation in the skin; in other words, an irritation wherever there is a nerve subject to be irritated: an irritation there can produce a paralysis as well as an irritation in a part of the brain. And therefore when we see a slight alteration in a very limited part of the brain cause a complete paralysis on the opposite side of the body, we are not to conclude that it is owing to the loss of function of voluntary power there where the disease exists in that small part, but that it depends or it has been brought on by an irritation starting from the place where we see the disease, and acting upon remote parts so as to produce the loss of the function. The mere fact, I may say, that a disease exceedingly limited in extent can produce a complete paralysis in the opposite side of the body, is sufficient to show that it does not depend on the loss of the function of will; for one-half of the body cannot locate in a very limited part of the brain the whole power of the will located in that brain. If it

were the other side of the brain which produced that complete paralysis, if we found that paralysis is more or less extensive, more or less durable according to the extent of the disease in one-half of the brain, then we might conclude that the disease has destroyed the power of will in that half of the brain, and thereby produced the loss of voluntary movement on the opposite side. But it is not what we see. We see that the lesion which has destroyed one half of the brain may allow voluntary movement, but a lesion which is not larger than a pea in any one part of the brain can produce a loss of voluntary movement. Therefore we are to admit that when the paralysis of movement comes in connection with disease of one half of the brain, it depends on an influence starting from the place where the disease is acting upon remote parts so as to produce a cessation of activity there, and a paralysis therefore.

SEAT OF THE FACULTY OF SENSATION.

There is the same reasoning to be made as regards perception of sensation. There also we find the same thing. I shall not insist on that point therefore. We know a thousand cases of disease occupying one-half of the brain that has not produced the slightest alteration in the power of feeling. But, if it is so it remains to be explained how it is, however, that the two halves of the brain come to be somewhat different, and that the physiological and pathological study of the two halves of the brain indicates great differences in that respect. If we pass in review what is known, we find very great differences indeed. Those differences depend on the fact that through the fault of our fathers and mothers, the faults that weigh upon us and have led us to make use of only one-half of our body for certain acts, and one-half of our brain for certain other acts also—we find that it is owing to that defect in our education that one-half of our brain is developed for certain things, while the other half of the brain is developed for other things. As regards what belongs to the left side of the brain compared with the right side of the brain, allow me to say the most important feature in its physiology or pathology is what a French physician has discovered. It is, as I have said already, that to that side of the brain belongs the faculty of expressing ideas by speech. Besides, that mental faculty of speech the left side of the brain possesses in a much more marked degree than the right the power of moving the tongue and larynx and muscles of the chest to produce the sounds of articulate voice. Articulation of sounds in speech in a great measure depends on the left side of the brain. I mean by the words "in a great measure" that it is chiefly the left side of the brain which has the power of acting upon those organs. So that more frequently in cases of disease of the left side of the brain do we find the difficulty in the mechanical part of the speech than in cases of disease of the right side of the brain. But that, although mechanical, is something like a gesture. There is a mental sign in it, and although it is a mechanical thing in itself, I cannot but consider it as representing some mental trouble.

MEMORY, NOT MUSCULAR POWER, LOST.

My pupil and assistant in London, who has become a very eminent man since, Dr. Hewling Jackson, has also insisted on that point, that it is the memory of direction of movements of the muscles which serve to articulate, which is lost, and not the mere power of moving the muscles of the tongue, larynx, or chest. I have had proof of it in a great many instances, that, when told to do so, the patient could move the tongue in any direction, could move the larynx and utter sounds very well, but could not articulate, so that it was the mental part of that mechanical act—the mental part of which was altered, and not purely a mechanical action lost. The left side of the brain is also the one that leads in gestures, and that by a very simple reason, which is, that it is the left side of the brain which leads chiefly the movement of the right arm, and it is chiefly with the right arm that we make our gestures. Still, it is likely, as pathological facts show, or at least appear to show, that even the motion of the left arm depends on the left side of the brain as regards gestures, as we find that in patients who have a disease of the right side of the brain the faculty is lost of making gestures with either the right or the left arm. That of course, shows, or at any rate seems to show, that the left side of the brain is the organ for gestures chiefly. In a few cases, however, of disease of the right side of the brain, the power of making gestures has been lost as well as in case of disease of the left side of that organ.

As regards the power of writing, there is a difficulty there, as you will early understand. Still there are many facts which show that the power of writing can be lost more easily, and is lost more frequently in cases of disease of the left side of the brain than in cases of disease of the right side of the brain—a difficulty which many of you have understood without my mentioning it. We conclude that the right arm is not rarely paralyzed in diseases of the left side of the brain, and as we write with the right arm, it is very natural that, on being paralyzed, we cannot write; but very few patients have lost altogether the movements of the fingers, and cannot form the least sign, though many of them cannot at all form a letter. They will be able, however, if they have a letter written by some one whose handwriting is not very much different from theirs (and sometimes when it is different), they will be able to imitate what is under their eye, but they cannot from memory write anything; at all events, they cannot express ideas by writing. They are attacked with what is called the agraphia—that is, a loss of the faculty of expressing ideas by writing. In many of these cases of patients attacked with agraphia there is a perfect power of moving the right arm. The arm is not paralyzed in cases where the left side of the brain is paralysed; there is no paralysis on the right side of the body or the left; no paralysis anywhere. In these cases, it has occurred sometimes that the patient could not write at all; so that it is clear that the loss of the faculty of expressing ideas by writing does not depend on the paralysis which in these cases had no existence.

INTELLECT MOST DEPENDENT ON THE LEFT SIDE OF THE BRAIN.

Another thing depends on disease of the left side of the brain more than the right side of the brain, and that is intelligence. Alterations of the mind manifesting themselves in the various forms of insanity depend more frequently, I should say, on diseases of the left side of the brain than on diseases of the right side. This is all I know now which belongs to the left side of the brain. The right side of the brain is quite different. From all that I have stated about the left side, as you will see, that organ is chiefly the organ serving the mental faculties, either in speech, or in intelligence, or in gesture, or in writing. That organ, therefore, is the important organ in our system adapted to the life of communication between ourselves and our brethren in a mental way. But the other organ—the right side of the brain, in some individuals, as you will

see, has the power of this one, and in all perhaps it might have had if the proper development had taken place; but this other serves contrarily to the first one. The right side of the brain serves chiefly to emotional manifestations, hysterical manifestations included, and to the needs of the nutrition of the body in various parts. There is, therefore, taking a large view of the differences between the two brains, this difference, that one of them—the left—serves to what we call the life of relation, while the right serves to what we call the organic life. This view, which I had put forward already five or six years ago, has begun now to receive demonstration from several physicians, and I am therefore the more emboldened in maintaining the correctness of that view of mine. The right side of the brain is remarkable in producing alterations of nutrition either in limbs that are paralyzed, or in the back. It is perfectly well-known that a number of patients die every month in every large city of ulcerations taking place on the *nates* or on the *sacrum* coming from an irritation of the brain. These patients are more numerous among those attacked by disease in the right side of the brain than among those attacked with disease in the left side of the brain. Either œdema or bed sores, either one or the other of those two kinds of ulceration is more frequent in cases of disease of the right side of the brain than in cases of the left side. The proportion is considerable. It is as two-thirds for the right side of the brain and one-third for the left. There are many other points which show the same thing. An ulceration in the lungs, an ulceration in the liver, a hemorrhage for instance and sudden inflammation—all these disturbances can take place under an irritation of the brain as I have shown; but in these cases it is chiefly the right side of the brain that has the power.

I have already said that hysterical and emotional symptoms are more common in cases of disease of the right side of the brain. This has been established already by a good many physicians—Drs. Brequet and Du Floret and a good many others, and myself. We have collected cases of paralysis in one-half of the body, caused by hysteria, and this proportion has been found; but of 121 cases of paralysis caused by hysteria (a paralysis which is usually merely transient, and very rarely lasts long)—in 121 of these cases there was disease of the brain on the right side 97 times, and disease on the left 24 times; so that the right side predominates in this class of affections. That paralysis exists on the left side of the body more frequently than on the right side you well know, and, as it affects chiefly the right side of the brain, it affects chiefly the left side of the body.

SIDES OF THE BRAIN UNEQUALLY DEVELOPED.

Now as regards other points, my pupil, Dr. Jackson, has ascertained that an inflammation of the retina produces amaurosis more frequently in both eyes from disease of the right side of the brain than the left side. Convulsions of the eye take place very frequently in cases of disease of the brain. I have ascertained in taking up the cases published by Dr. Prevost, Dr. Charmel, and many others and myself—I have ascertained that out of 69 cases in which these convulsions of the eye occurred there were 47 due to the disease in the right side of the brain, and 22 due to disease in the left side of the brain. Therefore there is a great difference between the two sides of the brain as you will see. It is so as regards general convulsions. Collender and myself have shown that general convulsions will occur much more frequently in cases of disease of the right side of the brain than in cases of disease of the left side. I have ascertained that both will occur far more frequently in cases of disease of the right side of the brain than in cases of disease of the same extent and the same location in the left side of the brain. Not only disease in the right side of the brain will have the greatest power in that respect, but it will also, if the patient does not die, produce a more marked paralysis; it will produce, also, a more extensive paralysis and a more durable one. So that, as regards degree, as regards extent, as regards duration of the paralysis, the right side of the brain is, by far, worse than the left, showing again that that side has the greater power of nutrition. There are a good many other points showing a difference of the same kind. I pass them over, as time presses. There is, therefore, as you will see, a radical difference between these sides of the brain. But now this depends, as I have said already, not upon the fact that the two sides of the brain are very different originally, but it depends on development. Every organ which is put in use for a certain function gets developed, and more apt to perform that function. Indeed the organ in size shows it. The left side of the brain, which is used most in our system, is larger than the right side of the brain. The left side of the brain besides receives a great deal more blood than the right side of the brain, because it has a preponderance in our system, and every organ that acts much, receives more blood. As regards the influence of action on the brain, there is a fact which hatters know very well. If a person is accustomed for many, many years from adult life—say from 20 up to 40 or more—to go to the same hatter, the hatter will find after a time that he has to enlarge the hat of his customer; and, indeed, a person advanced in life, even having passed 56, as your lecturer has, has a chance to observe such a change. There is no period of six months that has passed that I have not found that my hat, if neglected and put aside, became too small. The head, therefore, growing, is very strong proof that the brain grows also. Action, therefore, is a means of increasing size, is a means of development; and I have no doubt that a good many among you have observed that after they pay great attention to a subject, they have not only acquired knowledge on that subject, but become much more able to solve questions relating to that subject—that they have developed the part of the brain which has been used for the acts that they have performed, and that part has become far more able to perform its functions. This is perfectly well shown by everything in our system. We well know what a power a pianist can have, if that pianist continues to exercise his fingers and brain on the piano. But such a pianist neglecting to perform the acts that he was accustomed to perform before, it is very soon found that there is a defect. We must go on, therefore, exercising the organs in which we desire to have the great activity of life. There is no doubt, therefore, that the left side of the brain, as is shown by its great enlargement compared with the right side, and as is shown also by the quantity of blood that it receives, that organ is the one which is predominant in our system. But our being right-handed, shows it also.

RIGHT-HANDEDNESS NATURAL TO MEN AND ANIMALS.

It is quite certain that right-handedness depends something on nature. As you well know, the wildest populations in the world are right-handed, as we are. There is no population anywhere in the world that has not been found right-handed. There is therefore in man

a cause which makes the right side of the body to be selected as the one to be used the most, and together with that right side of the body the left side of the brain, which usually moves that right side, is increased considerably in power and in size. There is, therefore, a development given through some natural cause primitively, but a development given to the left side. We find that individuals who are left-handed make use of the right side of the brain, and when they become confused—when they lose the faculty of expressing ideas by speech—it is the right side of the brain that is affected, showing the connection between the development of one-half of the brain in the use of one arm, and the development of that same half of the brain in the faculty of expressing ideas by speech. There is therefore a connection between these two things, and on that point I shall dwell a little more in a moment. There is primitively a difference between the two brains, and Professor Gracciola has discovered in children the second convolution—the convolution of the left side of the brain—is developed quicker than the convolution on the right side. That may be in a measure owing to hereditary traits, I must say, but at any rate as there is an evidence that there is a natural tendency to make use of the right arm, it is certain that a part of that ability of development on the left side is due to something natural—that something natural will be found, if it is examined, in the greater supply of blood to that part. Even parrots and birds show something very interesting as regards right-handedness. Parrots perch only on the right leg, or mostly only on the right leg. Very few parrots out of 20 taken at random perch on the left leg, according to what Dr. William Ogle ascertained after having examined a great number of them. Parrots of course are known to have something like speech—a parrot's speech of course. It is perfectly well known that the mechanical part of speech belongs to them, and it is remarkable that their left brain receives also more blood by far than their right brain. There is therefore a relation between all these things in the development of the right side of the limbs and the amount of blood received by the left side of the brain. There is another point of importance. Prof. Broadbent and others have found that in the left side of the brain the mass of gray matter is greater and there are more convolutions than in the right side of the brain.

A REVIEW OF SOME POINTS DEMONSTRATED.

Now we come to four points of great importance for this lecture. They are the vital points, I may say, in the argument I have discussed here. The first of these points I have already spoken of. It is, that we find that agrophia is connected with the left side of the brain in persons who are right-handed, and with the right side of the brain in persons who are left-handed. This certainly, is a very strong argument to show that the side of the brain which serves the motion of one side of the body, that side—if the side of the body the one which leads, is the most important of the two—that side of the brain then is the one that serves chiefly to the mental life in our system. The mental life of our system, therefore, seems to be developed considerably in the organ which itself seems to be developed in a great measure owing to the action of will in one-half of the body. There is certainly a connection between these things, but that will come out more by and by

The second point is, that in children who have not yet learned to talk, or who have already learned only a little, if disease comes in the left side of the brain, the one, I repeat, which is the most rapid in its development usually, if disease comes to produce atrophy, so that the left side of the brain becomes useless, those children then learn to talk just as well, or nearly as well, as if they had no such affection, and they learn it with the right side of the brain, which is the only one acting. They were not born (the most of them, if not all of them, if there is any exception I don't know it) of parents who were left-handed, and there was no reason for their being left-handed. They had the misfortune of losing the half of the brain which served usually to the mental faculties, and other mental faculties got developed—the power of speech and action—and they make use of the left arm then just as well as any one of the right-handed people makes use of the right arm. There is in these facts clear proof that the right side of the brain can be educated to become a leader in mental faculties as well as the left side of the brain. There is a clear proof that the right side of the brain can lead movements and obtain execution with the left arm, just as most people who are right handed obtain execution of movement with their right arm. These facts, therefore, are decisive in favor of the view that I have for my object in this lecture.

The third point of importance is that with a given number of individuals, out of 100 examined by Dr. Wm. Ogle, who were left-handed, four only had learned to write with the left arm. They had been taught by their parents, although they were left handed, to make use of the right hand to write, and their writing with the left arm was very clumsy, the author states. In one of the cases he had to hear what the patient had to say; the patient being paralyzed in the left hand he could not have the proof; but in the others he had the proof, and could see. Therefore, the left side of the brain, even in persons who are left handed naturally—even in persons who make use chiefly of the right side of the brain—the left side can be educated so as to produce a very good handwriting instead, and better than the writing by the left arm.

The fourth point of importance is one on which I shall not dwell, as it implies a knowledge of medicine that you have not, but I shall state it in only a few words. It is exceedingly rare that the leg is affected to the same degree by paralysis as the arm, and the leg as you well know, is not a part which we develop as much in its movements as we do develop the right arm. If a patient is struck with paralysis, for instance, on the right side of the body, owing to a disease of the left side of the brain, he will lose more, if he does lose movement at all—he will lose more of it in the right arm which he has been accustomed to train than in the right leg. But, I repeat, that that argument cannot be understood well except by medical men. I pass it over therefore.

There is no reason whatever to object to one teaching children to make use of the two sides of the body. If you have been convinced by the arguments I have given that we have two brains, it is clear that we ought to develop both of them, and I can say, at any rate, as much as this, there is a chance—I would not say more, but at least I can say there is a chance—that if we develop the movements of the two sides of the body, the two arms and the two legs, one just as much as the other, there is a chance that the two sides of the brain then will be developed as regards the mental faculties, one as much as the other.

HOW TO DEVELOP BOTH SIDES OF THE BRAIN.

The facts that I have brought forward, the last especially—what I have called the four points of importance, and particularly the three first, show that there is a con-

nection between the development of the brain as regards the mental faculties, and the development of the brain as regards leading movements in one side of the body. There is a great chance, therefore, that if we give a good deal of attention, or, better, as much attention to the left side of our body as we give to the right, there is a great chance that we would have two brains as regards mental functions, instead of one as we have now. There is no doubt that we can improve the two sides of the body constantly. The facts I have mentioned as regards those children having atrophy on the left side of the body, do not leave room to doubt. It is clear we can develop the left side so as to make it exercise all the functions which exist in most of us in the left side of the brain, and if so in cases of atrophy on one side of the brain, why not so in cases in which we have two brains? I think, therefore, the important point should be to try to make every child, as early as possible, exercise the two sides of the body equally—to make use of them alternately. One day or one week it would be one arm which would be employed for certain things, such as writing, cutting meat, or putting a fork or spoon in the mouth, or in any of the other various organs in which both the hands and the feet are employed. In this way it would be very easy indeed to obtain a great deal, if not all. We know that even adults can come to make use of their left arm. A person who has lost his right arm can learn to write (with difficulty, it is true, because in adult life it is much more difficult to produce these effects than in children), and the left arm can be used in a great variety of ways by persons who wish to make use of it. It is perfectly well known that the left arm is employed in playing on the piano or on certain other instruments almost as well as the right arm. Therefore there is no difficulty in training children to make use of both sides of the body equally.

There is also another fact as regards the power of training. Even in adults who have lost the power of speech from disease of the left side of the brain, it is possible to train the patient to speak, and most likely then, by the use of the right side of the brain, the left side of those patients, with great difficulty, will come to learn. They always have more difficulty than do children, but they learn if they are taught in the same way. It is the same kind of teaching that we employ for a child when we try to make it speak, it is the same way that should be employed to teach an adult who has lost the power of speech. It is so also, as regards gesture, and the rest. I have trained some patients to make gestures with the left arm, who had lost the power of gesture with the right, and who were quite uncomfortable because their left arm, when they tried to move it, at times moved in quite an irregular way, and without any harmony. There is a power of training, therefore, even in adults, and if so, that power exists in children, and as we well know that we can make a child naturally left-handed come to be right-handed, in the same way we can make a child who is naturally right-handed come to be left-handed also. But the great point should be to equally develop the two sides. To point out this has been the object of this lecture, and I have now to thank you for having listened to the long and tedious arguments.

U. S. SURVEY OF THE WEST.

THE WHEELER EXPLORING EXPEDITION.

A VAST WORK, OF WHICH LITTLE HAS BEEN KNOWN OUTSIDE OF GOVERNMENT ARCHIVES—PLAN FOR A UNIFORM SYSTEM OF SURVEY THROUGHOUT THE COUNTRY—DETAILS OF THE WORK ACTUALLY PERFORMED—NEW AND INTERESTING FACTS RESPECTING COLORADO, WESTERN UTAH, ARIZONA, AND NEW MEXICO.

[FROM AN OCCASIONAL CORRESPONDENT OF THE TRIBUNE.]

WASHINGTON, April 30.—The surveys of our Western Territories, conducted at the expense of the Government, have assumed such magnitude in themselves, as well as in the interests which they involve, that the rivalry between them, which has now almost taken the form of a contest, becomes a matter of general interest. Of the two classes of Western surveys, those under civilian management and those under the War Department, the former have by far more greatly enjoyed the advantage of newspaper publicity. Of the labors of the War Department in this field, little has reached the public, except a comparatively brief sketch published in THE TRIBUNE after the return of Lieut. Wheeler's Expedition of 1873. Pending the discussion of the cost, proceeds and value of Territorial surveys which is likely to engage the attention of Congress within a few days, it seems desirable that a full account should be given of the work that has been done by the Bureau of Engineers of the War Department. As a preface to this account, a brief resumé of some of the facts stated in conversation by Lieut. G. M. Wheeler, U. S. A., the officer in charge of the United States Survey West of the 100th Meridian, will prove of interest.

VALUE AND PLAN OF SURVEY.

The need of an accurate and careful topographical survey of our western territory is not open to question. The experience of older countries may be taken in this matter as a guide. In Bohemia, for instance, maps have been published showing by gradations of color not only the elevations, but even the geological sections. As yet such a map of our country could not be constructed. The survey which has been organized and conducted under the War Department owes its origin and character to the absolute needs of that Department; the knowledge obtained is also of vast service to the Department of the Interior, to the settlers of the West, to scientific investigation, to industrial enterprises, and to the country at large.

The scheme of the survey primarily includes the entire mapping of the Territories; not a sporadic survey, touching here and there on points of interest, but a complete one, connecting the work with that of the Coast Survey and extending the determinations of locality over the entire area of the United States. The atlas sheets when finished will delineate the whole country west of the 100th meridian—an area of nearly 1,500,000 square miles. In the past three years the survey has covered 228,000 square miles, and at this rate it will take fully 10 years to complete it without assistance from other sources.

Better to facilitate topographical representation, and to preserve uniformity of publication as to scale and size, the region west of the 100th meridian has been laid off in rectangles, each embracing about 18,000 square miles. Each map published will be on a scale of one inch to eight miles, and will represent the area in one of these rectangles. Thus as the work proceeds the maps will

comprise a continuous series in atlas form. Six of these maps are now in the hands of the engraver, and the advance proofs indicate fine examples of topographical work, giving in detail the mountain systems, valleys, water-courses, routes of communication, &c.

SPECIAL FEATURES OF THE WORK.

A line drawn through Cheyenne, Virginia City, Tucson, Camp Apache, and Denver, will, said Lieut. Wheeler, approximately cover the area gone over by us. Our work must be exact, so that it can be referred to by future topographers. It is probably the best of any of the kind. One of the most important branches of the survey is the establishment of the meridian marks, and we do that with the utmost precision. No better work of that kind can be done, the probable errors being a minimum compared with any that have ever been made. Our meridian marks have already become of use to the local surveyors in numerous instances. The determination of the variation of the magnetic needle, which has heretofore given so much trouble, is another of the advantages obtained with the exact meridian.

Our survey, while it gathers information as to the general physical structure of the country, is eminently a mountain survey. It extends to the tops of all the mountains, and their characters and contour are a subject of special study. We have established the meridian at all the main astronomical stations. The percentage of area in the country surveyed suitable for agriculture is not large; a large part of the horizontal area covered by mountains is out of the range of cultivation. Small settlements spring up in the vicinity of the mining camps, but their permanency is uncertain, owing to the migratory character of the miners upon whom they depend for the sale of products. Within a radius of 15, 20 and 30 miles of the mining camps, these ranches are numerous, and the frugal Mormon, who thinks a great deal of a dollar, often brings his products 100 miles to market. With the development of the mining resources and a proper system of irrigation, the western half of Utah is capable of supporting 1,500,000 people

MINERAL INDICATIONS—TIMBER.

Since we commenced our survey, it has indicated a great many mineral resources that were not generally known before. We visited a great many mining districts, and have gathered a great deal of information which is entirely new. Besides the precious minerals there are copper, lead, iron, and coal. The coal fields in Utah are immense; perhaps greater than those in Wyoming on the Union Pacific Railroad, and when worked will prove of great benefit to the mining industries. The coal is of the caking sort, and is said to be of excellent quality. It will take the place of that now brought from Pittsburgh. Coal crops out from the 35th to the 43d parallel, and in various parts of the great Colorado Plateau. No tin, platinum, or zinc was found. There are evidences of petroleum, but nothing definite. Immense beds of rock salt are found, and also of alkali deposits, from which borax is manufactured. This latter substance, I am informed by persons who know, will become an important article of commerce, since, as it becomes cheaper, it can be put to new uses, and the demand may consequently increase with the supply.

The area of timber in Western Utah is comparatively small. Mr. Walker of the Census Bureau has made a map of the country west of the Mississippi that shows by graduation of color the present timber growth. We gave him such information as we could. There is an immense forest in Arizona and New-Mexico, something like those in the region of the lakes, or even larger. Pine, fir, and quaking aspen are the principal trees. There is some timber that could be utilized in the building of railroads for ties, &c. It would be of great advantage to the Southern Pacific and Atlantic and Pacific roads. We have discovered a new route for the former road, which they could follow with advantage. Besides the routes for railroads, we have examined north and south lines of communication; one near the Rocky Mountains, one along the meridian of Salt Lake, and another west of the Sierra Nevada. Salt Lake City and Denver are the only points south of the 40th parallel that promise to become great commercial centers.

Almost all of this country is destitute of rain for most of the year. There are generally two rainy seasons—in June and July, and in December and January. There are exceptions, however, in this wide territory. Among the plateaus, summer rains are prolonged fully three months.

SCIENTIFIC WORK—INDIANS.

The collections of specimens in natural history are very large, especially those of this last year, considering the brief length of time and small number of collectors. This part of the country has never been explored before, except along certain lines, and many new ornithological and botanical specimens have been secured. From Colorado alone we have over 12,000 botanical specimens, and we shall secure an exhaustive report on the flora of that country. We have a very good botanist; he is now with Prof. Gray. He is a man who will, from time to time, suggest some practical deductions. Our examinations include character of soils, humidity, temperature, &c. Dr. Loew, our chemist, has measured the temperature of the soil at the surface and a foot below, and made many analyses of the soils.

We have given some study to the Indian tribes, in the way of gathering vocabularies of their language, specimens of their work, accounts of their habits and disposition toward settlers and toward each other, and many historical facts that will be interesting material. We have annually sent over to the Interior Department a small map showing the lines that divide these tribes.

When it is understood that the expedition has often been divided into from ten to twelve parties, it will be apparent how a mass of information has been collected of no little value. This is the only systematic interior survey that has ever been undertaken by the Government, west of the Mississippi. It is very needful that there should be a unity of plan and purpose in this matter of surveys, as they come now from a variety of sources. Engineer officers are stationed at the Military Department Headquarters who are constantly making surveys for the information of the commanding officers in the opening of routes of supply, movement of troops, &c. At the headquarters of the army an Engineer officer is also engaged in compiling information; this finally all comes together and is embodied on a general map. Then, again, Congress has been authorizing expeditions from the Interior Department and Smithsonian Institution. I have prepared an elaborate plan covering cost, size, etc., for the prosecution of this work. It is based on a unit of force; but it has not yet gone beyond the War Department. We do not utilize anything obtained by either the Interior Department or Smithsonian Institution in the construction of our maps.

THE WORK OF THE SURVEY.

The following general subjects for observation will give an idea of the undertaking:

(1.) The establishment of primary geographical positions by astronomical methods.

(2.) Obtaining accurate topographical information by trigonometric methods of the various mountain systems of the valleys and of the detrital plains.

(3.) Determination of altitudes (hypsometrically).

(4.) Careful study of geological formations.

(5.) Examination and collections of the living and extinct fauna and flora.

(6.) Investigation of resources (wood, water, grass, and agricultural productions).

(7.) Ascertaining location and extent of precious and economic minerals.

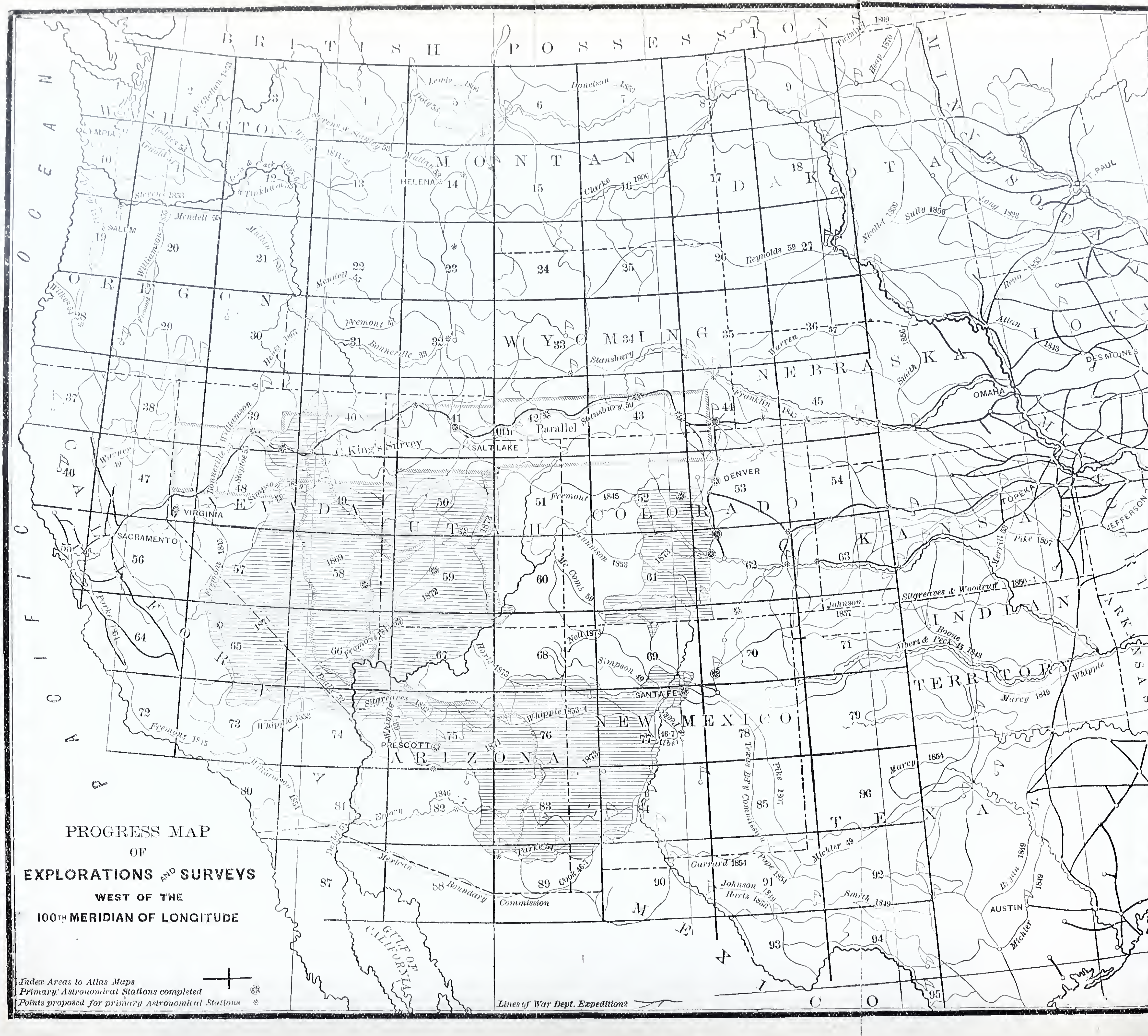
(8.) Observation of climatic oscillations and influences, and seasons of rain and snowfall.

(9.) Selection of routes of communication for rail and common roads, for military and other purposes.

(10.) Researches as to utilizing the present water-supply as a means of irrigation.

(11.) Ascertaining the condition of mining and other industries.

After the conversation with Lieut. Wheeler, of which the main features are given above, the following account of the work of the exploring expeditions under his charge was compiled from materials furnished:



PROGRESS MAP
OF
EXPLORATIONS AND SURVEYS
WEST OF THE
100TH MERIDIAN OF LONGITUDE

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EARLY EXPLORATIONS AT THE WEST.

England, Germany, Spain, Russia and France have made elaborate surveys and maps of their respective territory, the value of which is incalculable. In our own country the most finished and exact have been those of the coast, along which the principal interests were for a long time situated; next came the survey of the great lakes. The results of each of these undertakings are in the highest degree creditable to the officers engaged, and they have proved of great benefit to the country. The earliest history of surveys and exploration in our Western interior is found in the chronicles and adventures of the old Spanish and French travelers and missionaries. Their experience and the wonders which they relate are still full of interest, although the information they gained has been superseded by more accurate and detailed reports. One of the last and most entertaining of this class of historians was Padre Escalanta, a Spanish priest, who penetrated from the Gulf of Mexico to the Great Salt Lake of Utah. Some of the records of his travels are yet in the State Library at Santa Fé, N. M., others among the archives of the Spanish Government at Madrid.

The first to attempt an organized survey were Capts. Lewis and Clark, who were sent out under the auspices of the Government of the United States in 1804. They were absent until 1806. They were followed by Major Pike, U. S. A., 1805-7, who discovered the sources of the great Colorado of the West. Rector and Roberdean were the next, in 1818. After them, Major G. H. Long, U. S. A., conducted an exploring party, under orders from the Secretary of War. The first explorers of the sources of the Mississippi were Lieuts. J. Allen and Schoolcraft, 1832. The wanderings of Capt. Bonneville, U. S. A., from 1832 to 1836, were woven into a graceful narrative by Washington Irving. In the order of dates, subsequent explorations were made by the following officers: Commander Wilkes, U. S. N., 1838-42; Nicollet, under Bureau of Engineers, 1836-41; Lieut. J. C. Fremont, Engineers, 1842; Capt. Boone, of the Dragoons, 1843; Capt. Allen, 1843; Lieut. Fremont, 1844-46, assisted by Lieuts. Abert and Peck; Abert, Engineers, 1845; Franklin, Engineers, 1846-47; Abert and Peck, Engineers, 1846-47; Col. St. George Cooke, 1846-47; Warner, Engineers, 1847-49; Derby, Engineers, 1849; Lieut. Webster, Engineers, 1849; Lieut. Simpson, Engineers, 1849; Capt. Marcy, Infantry, 1849; Capt. Stansbury, Engineers, 1849; Col. Johnson, Infantry, assisted by Lieuts. Smith, Bryan and Michler, Engineers, 1849-57; Lieut. Parke, Capt. Pope, Capt. Sitgreaves, Lieut. Woodruff, Engineers, 1851; Capt. Marcy, assisted by Capt. McClellan, Engineers, 1852. From 1852 to 1857 the explorations and surveys for a railroad route from the Mississippi River to the Pacific Ocean were carried on, principally by officers of the Corps of Topographical Engineers. The resulting reports attained a worldwide reputation on account of their valuable data, and to this day they are frequently consulted.

TOPOGRAPHICAL MAPS.

To enumerate all the officers of the army who, fitted by education and training for such work, have taken part in or directed surveys in the Western Territories, is not necessary for the purposes of this letter. There is hardly any important portion of the West that they have not penetrated, and their labors have supplied the basis for the principal topographical maps of our country. The Engineer Bureau of the War Department has, since its organization, published several hundred maps, which are the most accurate, and, consequently, the most frequently consulted. Of the map prepared and compiled by Lieut. (now Major-Gen.) G. K. Warren, a large edition has been distributed. It is still the best map of Territories west of the Mississippi River. To the common intelligence there is no medium that conveys information so directly as graphic illustration.

In the prosecution of explorations and surveys west of the 100th meridian, it has been the aim of the officer in charge so to direct the operations that the results will meet at least a portion of the needs of the actual settlers, to enable them to carry out their enterprises. At the same time care has been taken to collect data upon scientific problems that are of interest and value. The facts ascertained by the expeditions are promptly reduced to practical results, and the work is vigorously pushed forward to completion. The volumes described hereafter, covering the surveys of Lieut. Wheeler, will be forthcoming as soon as Congress sees fit to order the publication. Photo-lithographic copies of the atlas maps will be issued in advance for immediate use.

ASTRONOMICAL WORK.

The duties in this branch of the survey at the main field stations, conducted with instruments of the most approved pattern, were first undertaken in the year 1871, although in 1869, at Camp Halleck, Elko, Camp Ruby, Peko, and Hamilton, Nev., longitude by telegraph had been determined by connecting with the Coast Survey station at San Francisco, signals having been sent from that point through the kindness of Prof. George Davidson of the Coast Survey and others. In the year 1871 the services of two principal astronomical observers were obtained, and connections were made that year with the meridian of the Naval Observatory at Washington and that of the United States Lake Survey at Detroit. The sending stations were Carlin, Battle Mountain, and Austin, Nevada. Subsequently in the field season of that year, the astronomical position of Fort George, Utah, was determined, connection being made with the Mormon Observatory at Salt Lake City. The longitude of Camp Independence, California, and Prescott, Arizona, was determined by lunar culminations, and at all the stations this year, latitude was determined by the use of the zenith telescope—the method originally introduced by Capt. Andrew Talcott of the Corps of Topographical Engineers.

By the exercise of care and after considerable labor in taking the field in 1872, the organization for astronomical work in its methods, personnel, and instruments, was considerably improved, and three parties, two fully equipped and moving between several points of the field, and one at the Mormon Observatory at Salt Lake City, were actively employed. The results of this season determined with creditable accuracy the positions of the following points: Beaver and Gunnison, Utah; Pioche, Nevada; Fort Fred. Steele, Cheyenne, and Laramie, Wyoming Territory. Observations were begun at the crossing of Green River by the Union Pacific Railroad, and completed in the following year. The observers of this season were Assistants J. H. Clark, E. P. Austin, and William W. Marvatt.

ESTABLISHMENT OF AN OBSERVATORY.

It was proposed to establish a connecting field-observatory at Ogden, Utah, from which point the signals for a large stretch of territory to the north, south, east, and west could be sent. A substantial brick observatory on a stone foundation was planned, and has been essentially completed except the dome. It has three observing rooms that may be increased to five, and is connected with the main wire of the West-

ern Union Telegraph Company. Connections may be at any time made with the wires of the Atlantic and Pacific Company, and of the Deseret Telegraph Company of Utah. To Prof. H. B. Herr of the Lehigh University of Pennsylvania tho superintendence of the construction of this building and the charge of tho observations necessary to connect it with the observatory at Salt Lake and that of the Lake Survey at Detroit were delegated. He was unablo to perform tho latter work, having to return to duty at the university. The observations were mado later in the season by Dr. F. Kampf. Three main field astronomical parties were organized, and took the field about the 1st of June, 1873, leaving it on or about the 15th of November. Thoy were in chargo of Assistants J. H. Clark, Dr. F. Kampf, and Wm. W. Maryatt, respectively. Prof. T. H. Safford of Dearborn Observatory, Chicago, joined the survey on the 15th of June, and conducted the observations necessary for the determinations of Santa Fé and Fort Union, N. M. The following main field stations were occupied during the past field season:

(1.) Santa Fé, N. M.	(7.) Georgetown, Col.
(2.) Fort Union, N. M.	(8.) Ogden, Utah.
(3.) Trinidad, Col.	(9.) Winnemucca, Nev.
(4.) Labrau, Col.	(10.) Virginia City, Nev.
(5.) Colorado Spring, Col.	(11.) Golden, Montana.
(6.) Hughes, Col.	(12.) Green River, Wyoming.

STATIONS DETERMINED AND RESULTS ATTAINED.

During the years 1871, 1872, and 1873 the results, now mostly calculated, give with the utmost exactness now attainable the latitude and longitude of 24 stations in the interior area west of the 100th meridian. These determinations are accurate and trustworthy, as the probable errors show a minimum compared with any as yet obtained of this class of work, either in this country or abroad. They have already been used in checking the surveys made upon the railroads, so that these lines of communication from tho Mississippi to the Pacific can be perfectly laid down upon the general map. A scheme developing from the line of stations reaching from Omaha to San Francisco has been begun, which, when carried out to meet the plan originally proposed, will be extended into an astronomical triangulation, which must, necessarily, take the place of the primary triangles in geodetic work, puro and simple, as applied by the Coast Survey in this country and by several surveys organized by the leading Governments of Europe. A large portion of our Western territory is covered with mountain forms, of which little is known, and presenting physical obstacles of such great magnitude as not to permit at present the slow and tedious operations of the primary triangulation prior to the commencement in skeleton alone of the final map. The secondary triangulation, having stations at prominent mountain peaks, and located in part from bases measured at the astronomical stations and from the prosecution of the trigonometric work, gives us points that hereafter may become vertices of a series of primary triangles for which some day tho country may call. At each of these stations tho truo meridian of tho place is established. Each of these lines having a known azimuth, will be of important use to the local surveyors and to tho engineers of railroads and other corporations in checking their lines of survey made for specified purposes. They will also be useful in determining the annual and other fluctuations of the magnetic needle—an element entering so largely into the record that gives a title to lands.

In due time the standard meridians used by the public surveys, carried respectively from the Valley of the Mississippi westward, and from the Pacific coast eastward, may be adjusted to these geographical positions—a matter of no little importanc At most of these stations substantial stone monument constituting observing piers, have been established, an can always be identified. This branch of surveys bein the first and most necessary, after it shall have bee prosecuted with vigor, as it will be for several years b different parties of the War Department, the necessa data will ultimately be available, so that the accum ated material from a variety of sources, both public an private, may be aggregated upon the general map of th country, which is constantly revised at the Engineer D partment, and also upon maps of the geographical mi tary departments of the West, now in process of compil tion at the Engineer Office, Headquarters of the Arm Astronomical observations for minor checks upon top graphical work are conducted by officers of the corps engineers, who have also the executive charge of th moving field parties. The mass of geographical po tions already gathered, having prominent natural a other objects for their initial points, will soon be pu lished.

TOPOGRAPHICAL WORK.

The present survey was first undertaken while th officer now in charge was on duty upon the staff of Br vet Major-Gen. E. O'C. Ord, then commanding the mi tary Department of California, to which duty ho w assigned in the Fall of 1868. In the Spring of 1869 the e pedition for the reconnoisance in South-Eastern N vada, then an almost *terra incognita*, was organiz under the authority of the late Major-Gen. Geo. Thomas, commanding tho Military Division of the P cific.

Since the expedition of Capt. Timpson in 1859, fro Great Salt Lake to Virginia City, no military parties ganized for survey of the Western interior had been the field with the exception of the survey of the 40 parallel, Clarence King in charge, who had begun the surveys in 1867. At the breaking out of the war, th Corps of Topographical Engineers, to which had be intrusted prior to this date this class of duties under Government, was taken from these and other works a similar character, and sent with the armies in field. During the war this class of interior surveys r mained dormant.

After the war, engineer officers were detailed at t headquarters of the several military departments a were called upon to carry out surveys of various kin The amount of money allotted was very small, and it w impossible to go to the expense of assistants other th in the astronomical and topographical branches of t work, where ability for scientific mapping of the resu is a prerequisite. This reconnaisance occupied the ent season of 1869, and its results were reduced at the of in San Fancisco. A preliminary report and maps w published for the use of the Military Department California, and another map, upon a scale of one inch to twelve miles, was made for tho uses of the War parrment. The final report of this expedition is n completed.

The officer in charge, having changed his station Washington, D. C., commenced in the early Sprin 1871 the organization of a large expedition to take field that year. The several field parties left the Cen Pacific Railroad at Carlin and Battle Mountain, N moving in a southerly direction, closing their labors the end of the season at Tucson, Arizona. In ma respects this was one of the most extraordinary exp ditions that ever entered our Western territory; duties were both on the water and the land. A separ or sub-expedition ascended the Colorado River fr

Camp Mojave to the mouth of Diamond Creek, in the Grand Cañon. The area covered was over 80,000 square miles, a part of this being the most desert, difficult, and dangerous of any like area within the United States.

EXPLORING THE DEATH VALLEY.

This was especially the case with the great Death Valley in South-Western Nevada, wrinkled with many mountain elevations, between which lie elongated valleys or detrital plains, where the familiar alkali of this peculiar region everywhere meets the eye. The expedition crossed the Death Valley of California along four separate lines, enduring much hardship and many privations from heat and thirst. This peculiar basin interior, being at its greatest depression below the level of the sea, is most remarkable from the fact that the range of mountains lying to the west rises nearly 10,000 feet. Here are found, besides the precious minerals, bodies of timber, springs and running streams, and a peculiar climate; here arise sickly vapors that, in the light of the sun reflected upon the alkaline plains, might be supposed to be sulphurous fumes born of the infernal regions.

The season was particularly fruitful in unraveling the variety of topographical forms in and around the Grand Cañon of the Colorado, along the edges of the great plateau system, in the valley of the Colorado, that occupies large portions of territory in Arizona, Colorado, Utah and New-Mexico. It was proposed this year by the leader of the expedition to name this entire section the "Colorado Plateau," to be divided hereafter into sub-plateaus and mesa-systems. This expedition was fully eight months in the field, and left the Territory of Arizona in the middle of December, 1871. The boat party leaving Camp Mojave on Sept. 13, reached the mouth of Diamond Creek on Oct. 19. The ascent of the river was comparatively easy from the Black and Bowlder Cañons, until reaching the point of crossing to the southward, when, not having fully anticipated the increasing obstacles to entering the jaws of the Grand Cañon, the dangers of the trip were suddenly realized; and only after much privation and severe labor, with a scarcity of food, did the party, hemmed in by frowning walls, reach the mouth of Diamond Creek, where relief awaited them. The exciting scenes and thrilling adventures connected with this trip, will form one of the entertaining features of the published reports. The most easterly point reached this year was Camp Apache, A. T., near the head-waters of the Salt River.

Death Valley in California is a detrital sink of unique physical characteristics, and differs entirely from what it was supposed to be in 1869 by the majority of the inhabitants of Nevada living near a line leading from Camp Halleck via White Pine to Pahranagat Valley. The country thus denominated was really the great "Death Valley" of South-Western Nevada, and covers a large space in the system of Interior Basins that have the Wasatch Range as an eastern and the Sierra Nevada as a western limit. This whole region presents a series of valleys or detrital plains, each entirely inclosed by the ridges of Cordilleras that are more or less distinct as a series of mountain masses. The "Death Valley" proper is one of the most remarkable of all known interior continental depressions, and has portions near the center of its axial line below the level of the sea, although far inland, and lying much to the north of the lower border of the great Interior Basin. It is the sink of the Amargosa River, which has its source in the areas of drainage formed to the south and east of Belmont, Nev., traverses the desert of that name while passing southward, until, reaching lat. 35° 41′ 5″, it makes an abrupt angle to the west, and thence, at right angles to the north, reaches the point of greatest depression, a little less than 300 feet below sea level, in the heart of Death Valley proper. This valley, of the ordinary oval form, is fully 70 miles in length, varying from 5 to 15 miles in width, surrounded by frowning mountains of volcanic and sedimentary origin, the Telescope Range, rising higher than 10,000 feet. The line crossing this dismal area from the mouth of Death Valley Cañon to the thermal springs in Furnace Creek, presenting a labyrinthian maze of efflorescent, saline forms, creates at the level of vision a miniature ocean, the vibrations of whose contorted waves has a sickening effect upon the senses. The lurid glare, horizoned by the bluish haze radiated from the mountain sides, appears focussed to this pit, though broad in expanse. It seems, coupled with the extreme heat, to call for the utmost powers of mental and physical endurance.

The journey through the Valley of Death occasioned the utmost apprehension evinced through the entire season. To this was added the effect of the fearful cloud-burst experienced while among the Telescope Mountain, to the west, and the absence of the guide who had ventured toward the north-western arm of the Valley, it was feared, to return no more. The transit of 48 hours in a temperature that remained at 117° F. at midnight, so exhausted both men and animals that further travel was rendered precarious.

A PATHLESS FOREST.

San Francisco forest, through which Lieut. Ives conducted his land explorations, was traversed for a distance of nearly 200 miles from San Francisco Mountain to the Sierra Blanca range. The subsequent expedition of 1873 extended its limits far into New-Mexico, proving it to be probably the largest continuous forest area in the United States south of the fortieth parallel. The expedition returned to Washington in December, and at once began the preparation of maps, which will be pushed rapidly to completion in pursuance of the proposed atlas scheme. Much of the data was late in being received from the field, and some delay was experienced; still, satisfactory progress is making. In the Spring of 1872, with a larger appropriation, the Survey entered upon its duties with a more completely organized force, having for its field portions of Utah, Nevada and Arizona. The point of departure and return was Salt Lake City. The experience gathered by the topographical assistants and the addition of new skilled labor made the Topographical Corps of this year quite efficient, and permitted the elaboration of methods to meet the growing wants of this class of survey, aided by improved and perfected instruments. The area covered by the topographical work for this year is not so large in extent, but the result is fully as valuable, as more details were gathered. In 1873 the Topographical Corps was still further enlarged, experienced persons being retained and others added. The instruments and methods were also further perfected, and the work of exploration for this year fully elaborated into an entire survey of the new and interesting regions visited. The parties, six in number, took the field from Salt Lake City, Denver, and Santa Fé. The localities of the prominent natural objects, such as mountain peaks, mesa edges, buttes, &c., are determined by a species of secondary triangulation. Each belt of triangles is checked at distances not exceeding 200 miles by bases that now or hereafter will be further checked by the primary astronomical positions. Minor details are gathered by the topographers, using ordinary trigonometric methods for horizontal

and vertical distances, so that within specified areas a sufficient amount of material for the scale proposed is gathered. The Survey was most successful in obtaining the requisite topographical information over large areas in Utah, Colorado, Arizona, and New-Mexico. At the present time this is rapidly undergoing reduction for the final atlas sheets. The moving field parties are usually so constituted as to be able to subdivide, and retain in each an executive, astronomical, topographical, meteorological, geological, and natural history assistant.

Topography is one of the most important branches of the work, since it is to trustworthy maps of the country that we must always look for the most ready and certain knowledge of its general features. In this country it has not as yet attained the dignity of a profession. It is hoped, however, that at no distant day it will command the attention it deserves at the hands of our scientific institutions. Up to the present time, the area covered by the survey has been as follows:

TABLE SHOWING THE AREA SURVEYED.

	1869.	1871.	1872.	1873.	'69-'73
Nevada	26,400	27,200	6,200	....	59,800
California	....	19,150	....	....	19,150
Utah	....	....	34,400	2,500	36,900
Arizona	....	32,400	9,900	17,500	59,800
New-Mexico	....	....	....	31,000	31,000
Colorado	....	....	....	21,500	21,500
Total	26,400	78,750	50,500	72,500	228,150

The total cost of this work has been a little less than $225,000; approximately one dollar per square mile or one-eighth of a cent per acre.

GEOLOGICAL WORK.

The Geological Corps of the Survey has been progressively enlarged in the successive field seasons. Mr. G. K. Gilbert remained a member of it during 1871–2–3. In 1871 he was assisted a portion of the Summer by Mr. A. R. Marvine, who was succeeded in the following years by Mr. E. E. Howell. In 1873 the Survey was so fortunate as to secure also the services of Prof. J. J. Stevenson, and in the same year Dr. O. Loew, in addition to his multitarious labors in other departments, assisted in the geological work.

In the season of 1871 Mr. Gilbert followed a devious course in Nevada and California, starting from Carlin on the Central Pacific Railway and touching in succession the Bull Run mining district, Battle Mountain, Belmont, Hyko, and Pioche, in Nevada; Camp Independence and Desert Wells, in California; and Camp Mohave, Arizona. From the last place he accompanied the boat party up the Colorado River to Diamond Creek, at which point land travel was resumed. At the crossing of the Colorado, near the mouth of the Grand Cañon, he was met by Mr. Marvine, who had just commenced his geological examinations at St. George, Utah, and between that point and Camp Apache the routes of the two geologists intersected a number of times, and they were enabled effectively to combine their observations, the chief bearing of which in this region was upon the definition of the southern or south-western boundary of the great Plateau System.

All that portion of the United States west of the Plains is characterized by corrugation; that is, the geological formations once horizontal have been bent and broken and thrown into ridges so as to produce a mountainous country. The ridges vary greatly as to hight and length, but agree in a general northerly trend; so that in traveling north and south, it is generally easy to follow valleys, while in going east or west one is confronted by range after range that he must climb or go around. In the lower parts of this great mountain system the slow but indefatigable agencies of rain and stream have accumulated so great an amount of detritus that the valleys are clogged and the mountains nearly or quite buried. In this way have been produced the great desert plains of Utah, Arizona, and Southern California—vast seas of sand and saline clay, from the surfaces of which a few half-sunken peaks jut forth as islands. These intermissions of the mountainous character are mere concealments, not interruptions of the corrugated structure; but that structure is interrupted in one place—perhaps in others, but in one notably—by a tract in which the strata are almost undisturbed. The general surface of this exceptional region lies from 6,000 to 8,000 feet above the ocean and it is intersected by the celebrated cañons of the Colorado and its tributaries. By these gorges and by other modifications, chiefly dependent on erosion, it is divided into a great number of plateaus which the surveys now in progress are defining and naming. The geologists of these expeditions have found it convenient to designate the region, considered as a geological province, as the region of the Plateaus, or the Colorado Plateau System. It is surrounded on all sides by areas of corrugation, the ranges at the east constituting the Rocky Mountain System proper, and those at the west having been designated as the Cordilleras. At the north and south these mountain areas coalesce. The northern portion of the Plateau System falls within the belt of country studied by the geologists of the Fortieth Parallel survey and rendered accessible by the Union Pacific Railroad, has become tolerably well known. The definition of the southern half has been accomplished by the recent Engineer explorations.

WESTERN LIGNITES—AGE OF THE ROCKY MOUNTAINS.

The field of operations in 1872 comprised parts of both Cordillera and Plateau regions, and included their joint boundary from the Wahsatch range south-westward to the Colorado River. At the opening of the season Mr. Gilbert crossed the Cordilleras westward from Salt Lake City to the Nevada line, and returned eastward to Beaver, near the line of separation, where he was joined by Mr. Howell, who had spent most of his time east of the bounding line. Between this rendezvous and the next at Toquerville—which also happened to be near the same line—these gentlemen exchanged fields, Mr. Howell keeping to the west among the mountain ranges, and Mr. Gilbert exploring the plateaus about the head waters of the Sevier and Virgin Rivers and Kanal and Paria Creeks. In returning to Salt Lake City Mr. Howell once more bore to the west—this time so far as to touch the mining town of Pioche, Nevada, where a week was spent in a geological examination of the locality; and Mr. Gilbert, after visiting the Colorado cañons at Paria and Kanal Creeks, returned northward over the Sevier Plateau. One of the most interesting subjects of study during the season was the record of an ancient lake that covered the Sevier and Great Salt Lake Deserts, and which Mr. Gilbert refers to the glacial epoch. A great deal of attention was also given to some faults and folds within the Plateau region, of far less magnitude than those found among the Cordilleras, but of the greatest interest, since they are the simplest elements of mountain structure and their study promises to throw great light on dynamical geology.

In 1873 the work of Prof. Stevenson, who accompanied Lieut. Marshall, was confined to the Rocky Mountains, and was quite independent of that of the other geologists. His investigations led him to very definite conclusions in regard to the age of the Western lignites and the age of the Rocky Mountains, and his notes comprise

important additions to our knowledge of the distribution of the strata and crystalline rocks of the region, of its ancient glaciers, and of the relation of its economic minerals to its geological structure. Mr. Howell, starting with Lieut. Hoxie from Salt Lake City, remained with his division nearly to the end of the season. The earlier part of the Summer was spent in a portion of the Plateau region immediately east of that examined in the previous year, and was largely devoted to the study of the system of faults, there well displayed. At Fort Wingate he passed—though at a later date—the initial point of Mr. Gilbert's examinations; and in the area to the south—the principal area for that season—the routes of these two geologists were so near as to enable a combination of their work. Dr. Loew's geological examinations moreover were in this region and tracts adjacent to it. Among the results of the Summer were the further definition of the boundary of the Plateau—continuing the work begun in previous years, the recognition and partial survey of some almost unknown volcanic belts of great extent, and the accumulation of many new facts in regard to the great cretaceous coal-field of the Plateau region.

Vol. IV., "Geology," will comprise reports by Messrs. Gilbert, Marvine, Howell, and Stevenson, upon the geology of the regions they have severally examined, and by Drs. Hoffman and Loew upon mineralogy and chemistry. The chemical report will include analyses and discussions of soils, minerals, rocks, mineral waters, coals, and vegetable principles. Among the topics treated in the geological reports will be "the Lignites," geologically and economically considered; iron ores, metalliferous veins, springs and artesian wells, erosion, mountain structure, descriptive and theoretical; stratigraphy and the distribution of the several formations, metamorphic rocks and metamorphism, eruptive rocks and their distribution, and the phenomena of the glacial epoch.

The illustrations will consist principally of woodcuts incorporated with the text and designed for the elucidation of the matter rather than for mere embellishment. Some points of structure and especially certain peculiar phases of erosion will be illustrated by full-page heliotypes or other prints from photographs made in the field. An atlas of geological maps, uniform in size with the topographical, and of course based upon them, will accompany the report.

MINES, MINERAL WATERS, &C.

More than 150 districts of precious metals in the territory covered by the survey have been visited and examined as far as circumstances permitted. The reports show a great number of points at which precious minerals have been discovered. Their value will be realized in connection with the geological and other investigations, and the mining localities will be indicated in the maps. The want felt of comprehensive and accurate maps of the mountain areas about which so little is known has repeatedly been called to the attention of Lieut. Wheeler by prominent men both in public and private life, and especially since the discovery of precious minerals has awakened a new and vast field of industry in those distant regions.

Mineral waters have been collected at various points, and in the more interesting cases several gallons of the water were evaporated, the residuum being kept for a more exact determination of those that occur only in small quantities.

The most interesting mineral springs were those of "Ojos Calientes," on the Jemez Creek, about 50 miles west of Santa Fé. These springs are situated in a deep but spacious cañon, the walls of which are over 1,500 feet in hight. The creek rushes through over a rocky bed with great rapidity, and some Mexican farmers have built huts along the margin. Springs of this class are invariably warm, the cold springs showing limited if any mineral qualities.

The principal warm spring is in continuous and violent action, a current of carbonic acid escaping through the water, which has a temperature of 169° Fahrenheit. This water is used for bathing and drinking by the Mexicans, who flock thither. This spring was found to contain chiefly chloride of sodium, sulphate of soda, carbonate of lime, carbonate of magnesia, and chloride of lithium. Smaller springs of similar composition, a few steps from the chasm, contain, in addition, carbonate of iron, and have a lower temperature, 108° to 130°. Two miles above this group of springs is another, quite distinct, 42 in number, all issuing from calcareous mounds, undoubtedly former spring deposits. There is a cave in one of these mounds whose walls are coated with glittering crystals of calcite, and two snow-white columns stand in front. These springs contain, beside the above-mentioned substances, carbonate of soda, their temperature ranging from 89° to 105°. A quantitative analysis has been made from springs of both groups, and will be reported in the final volumes. These springs have some similarity to those in Marienbad, Bohemia, and undoubtedly deserve attention. At some future time we may here find one of our fashionable watering-places. Mineral springs in the cañon of the Rio Francisco at San Isidro and other localities, have been carefully examined. Lithia was found accompanying the soda salts; borates, which are so frequently encountered in Nevada, have not been found yet in New-Mexico and Arizona.

A FARMER BECOMES A MINER.

An extensive collection of ores from New-Mexico and Colorado was made. These will be subjected to analysis. There is a vein of red oxide of copper of 80 feet width and 3 feet hight, in quartzite, in the vicinity of the Rio Francisco. A deposit of silicate and green carbonate of copper of about the same hight and of a width of 45 feet occurs on the Burro Mountains. Some new copper mines were discovered by the parties of the expedition on Mount Turnbull and in the Gila Valley near the Rio Bonito. The silver mines of New-Mexico are extensive, containing chloride of silver, native silver, argentiferous galena, and argentiferous iron pyrites in many places. A characteristic ore is the deposit of chloride of silver in slate and silenite at Silver City. On the Madelina ruts occur argentiferous cerrussite and massicote. Gold is found in various places in sand along the Rio Francisco and the Rio Membres; in quartz sandstone, talc, and soil on the Placer Mountains. One farmer in the vicinity of Silver City subjected the soil of his corn-field to a washing, and obtained such favorable results that he sunk a shaft. The profit of his labors last year was $1,800 in gold.

The region above 7,000 feet receives nightly dews, and has occasional springs and abundance of timber and grass. The country below this altitude suffers from the dryness of the climate, but the streams are often flanked by belts of good bottom lands that may be irrigated. A report will be made describing in detail the lands suitable for farming. In New-Mexico and Arizona many soils were analyzed. Lithia was present in all of them—a substance not so common in other countries. Potassa and phosphoric acid were found in all in sufficient proportions to insure production of crops. In some localities the soil contains as much

of these elements as the best soils known. Some soils were found deficient in lime, some in sulphuric acid; but this want can be easily supplied by an addition of gypsum, which occurs in many places.

There is also a class of soils productive without irrigation. In such cases the underlying strata probably furnish water, which ascends by capillary attraction. Specimens of such soils have been taken in sealed bottles to determine the hygroscopic moisture of the subsoil. This was found to be 4 to 5 per cent, while at the surface it was was from 1 to 2.

The valley of the Rio Grande del Norte, in New-Mexico, recalls the features of the Egyptian Nile. A large population is entirely dependent upon the river. An annual rising of the waters carries a muddy sediment superior in fertilizing properties, as was proved by analysis, to that of the great African river. While the amount of phosphoric acid is nearly the same, the amount of potash is considerably higher. Thousands of acres are lying idle along the valley of the stream awaiting the enterprising farmer.

PLANTS, TEXTILE FIBERS, &C.

There are many plants growing in New-Mexico and Arizona which have strong fibers that could be utilized for the manufacture of rope, paper, &c. One such species, *Yucca Angustifolia,* is now utilized at Denver, but there are many more. The root of this plant is used by the natives as a substitute for soap, and is highly prized on account of its cleansing properties for woolen goods. Another plant of great interest is the *maguey* or *mescal,* growing in Southern Arizona—a peculiar species of yucca. The plant consists of about 80 to 100 lanceolate leaves from two to three feet long, pointed to a sharp thorn at the end; all the developed leaves are concentrically united at the ground; those undeveloped—the heart of the plant—remain soft and perfectly white so long as the sunlight is kept away by the surrounding outer leaves. The Indians bake this heart in coals for eight or 10 hours, when it acquires an exceedingly sweet taste, much like honey. The Mexicans, also, prepare from this baked mescal an alcoholic beverage. The fact of this substance turning into sugar by simple heat has no parallel in our experience. Specimens of all valuable plants collected during the survey, including such as are used by Mexicans and Indians for specific diseases, will be subjected to chemical investigation. The geographical distribution of plants affords a study of peculiar interest in those regions where the altitude changes from 5,000 to 8,000 feet, and on some occasions, 10,000. Above 6,800 feet there are vast forests of pine and fir, and the climate of the eastern mountains, while below 5,000 feet, is a region where the cactus grows. The cacti are especially developed in Southern Arizona, where the grand cactus (*Cereus giganteus*), 30 to 40 feet in hight, and three to four feet diameter, is preëminent. Between the region of those cacti and the zone of the pine, grows the everywhere prevalent juniper, in higher altitudes accompanied by piñon, a peculiar conifer, with an eatable fruit. A large collection of plants was made in New-Mexico and Arizona.

CURIOUS BOTANICAL OBSERVATIONS.

It is hard to believe that the vegetation of the plains, which is so strikingly somber in its *ensemble,* is really as diversified as that of most other regions of similar area. Certain orders, as the Leguminous family about Denver, or the Cactus family further south, do preponderate over the others, just as other orders in other places do on the remaining plants. But there may be as many species and genera in one place as the other, only it requires more than casual observation to distinguish between the allied forms. The vegetation of the plains disturbs all our preconceived ideas of plant life by presenting an extraordinary class of representatives. The physical conditions are just as peculiar as the plant life One is the exact measure of the other. Imagine a vast open expanse absorbing, without the protection of an intervening foliage, most of the sun's rays, and from want of aqueous vapor in the air parting with that heat as readily at night, and the reason why our familiar forms of plant life are crowded out of existence is obvious. They are unable to endure an alternation of temperature so extreme and so rapid.

The mountain flora is especially fresh and attractive, and up almost to the limits at which flowering plants grow the luxuriance and beauty of the vegetation are wonderful. Under the great diversity of physical conditions furnished by the deep shade of the pine woods, the sunny valleys, the rocky slopes, and the snow-fed Alpine bogs, plants seem placed where every tendency they may have to vary is intensified, and it does not in the least surprise one to see some of our best-known forms going off in all sorts of unexpected developments.

The best agricultural region visited by the botanist during the past season was the San Luis Valley. While much of it is barren and unpromising, much more is capable of raising good crops after irrigation has been practiced. The portions bordering some of the creeks are absolutely covered with the most luxuriant growth of grasses and sedges. Indeed in many places one may ride a mile through the grass without the animal being seen among the tall grass. The following facts show plainly the productiveness of the soil ·

	Yield per Acre. bush.	Weight per bush. lb.
Oats........	40 to 50	40
Barley......	40	55
Bald Barley	50	75
Wheat	30	65 to 68
Potatoes..	250 to 300 bush. ..	

Turnips, onions, beets, cabbages, and radishes grow to an immense size. Along the Rio Grande, in the southern portion of the valley, all our familiar garden vegetables were readily raised.

The foot-hills and higher mountain ranges back of these have much valuable pine and spruce timber growing upon them, but it is probable that ere long the greater needs of a rapidly increasing population will have exhausted the supply, and it might therefore be wise in Government to become an active participant in the rage for timber planting which is so prevalent in portions of the West.

In certain places the curious fact was observed, that trees attained their maximum hight and diameter just before the level of timber-line was reached and suddenly were reduced (the same species) in size, disappearing entirely a few hundred feet higher up.

METEOROLOGICAL WORK.

A system of observations with the barometer and psychrometer, combined with a journal of our meteorological phenomena and observed peculiarities of climate and climatic influences is adapted to the fixed stations at the astronomical basis, and to the movable stations of the various field parties. A voluminous record is thus accumulated, containing the elements of much information upon points important to the survey, the elimination of which, from the mass of figures, is a labor of no trifling character. The primary object of this record is the barometric determination of the relief of the country traversed, no other means sufficing except to supplement this general plan.

From the fixed bases of the barometric stations the theodolite and spirit level give local relative altitudes with great exactness; the course of streams, the dip of strata, and even the character of vegetation contribute hypsometric facts in more or less certain figures. And all these sources of information are utilized, but altitudes so determined are only relative and must be fixed by the primary determination by the barometer, which offers a common reference for the survey. In reducing and computing the numerous observations, they are treated in accordance with the latest authoritative views upon barometric hypsometry, and the altitudes so determined will give the relief of the country very satisfactorily.

The Record furnishes statistics of temperature, humidity, rain, snow, and all facts relating to the climate of the country which could be collected. This information will be published in the condensed form of tables, with such an analysis of the barometric readings as will best exhibit the action of the forces at work. It is hoped that by a careful arrangement of the data, material may be presented for further meteorological investigation and assistance rendered in determining the laws of atmospheric movement and their influence upon the barometer.

NATURAL HISTORY.

In 1871, the celebrated Collector F. Bischoff, assisted by Drs. Hoffman and Cochrane, made abundant and valuable collections in the line of entomology, botany, ornithology, &c., many new species of Coleoptera being found. In ornithology the contribution was valuable in numbers as well as in embracing many forms rare and new. Similar results were obtained as to serpents and reptiles. An extensive herbarium of the region visited was obtained. Unfortunately, however, these collections were rendered partially valueless by the Chicago fire, in which the note-books were lost and Mr. Bischoff himself perished.

In 1872 the services of Dr. H. C. Yarrow, U. S. A., of eminent ability both as a surgeon and a naturalist, were secured, with Mr. H. W. Henshaw as an assistant, and Mr. M. S. Severance as an ethnologist. The party under Dr. Yarrow took the field early in the season, their labors resulting in a collection of 800 birds, between 300 and 400 reptiles and a large number of fish, insects, plants, &c. which, on examination by competent naturalists, proved fruitful in the way of elucidating many points with reference to geographical distribution. A large botanical collection was also made. Particular attention was paid to ethnology and philology, and numerous rare crania were added to the extensive collection of the Army Medical Museum, while to the Smithsonian Institution were contributed numbers of specimens illustrative of the manners and customs of the rapidly decreasing tribes which inhabit the section visited, together with several vocabularies of Indian languages. The crania in question have already served a good purpose, not only in the way of materially increasing the number of interesting specimens to be found in the national collections, but also as a means for the comparative study of the subject of craniology. The vocabularies will form part of an extensive work on Indian languages now in course of preparation by the Institution.

NATURAL HISTORY COLLECTIONS IN 1873.

The expedition of 1873 took the field June 1, and though the period of its operations was greatly curtailed by reason of the early close of the season, the result was a collection never, perhaps, exceeded either in the number or value of the specimens, by any made in the same length of time and under similar difficulties. It embraced 1,200 birds, among which many were entirely new, and was fruitful in the way of nests, eggs, fish, reptiles, &c. In botany the field was especially large, and included many rare and valuable specimens. Perhaps no larger collection of the kind was ever secured in a single season in the Western region. It required the services of four of the most distinguished botanists to work up the specimens. A pre-eminently superior collection in ethnology was another of the valuable contributions of this year. The party during this season consisted of Dr. Newberry, Dr. Rothrock, Mr. Henshaw, Prof. Wolfe, and Dr. Loew. The collections were safely transmitted to the Smithsonian Institution, for competent examination by the collaborators of that establishment. As to the birds collected during this period, the gratifying assurance has already been received from the eminent ornithologist, Prof. Baird, that many of them were in such splendid condition as to justify their being sent to Europe to be mounted for exhibition in the national museums. Reports on these collections will be embodied in a quarto volume, with illustrations of the rarer forms. The services of Dr. H. C. Yarrow have been secured by Lieut. Wheeler for the work of 1874. Mr. Henshaw is retained as his assistant, being an eminently successful collector in ornithology. Dr. Rothrock, skillful in botanical collection, will have charge of that department of research. Many other specialists have been invited to join the expedition.

PHILOLOGY AND ETHNOLOGY.

Most valuable data for future elaboration have been secured for the students of philology and ethnology. Many vocabularies have been recorded by the efforts of members of the Expedition, according to the Smithsonian blanks, forms, &c., from the Utes, Pah-Utes, Jase-Utos, Apaches, Navajos, Pueblos, Mojaves, and others, all of whom should probably be classified as one great family, their customs, language, and habits being in some respects very similar. Many ancient mounds have been thoroughly explored, and their interesting contents will without doubt afford us valuable and instructive facts in regard to races long passed away from this earth. In some, skeletons, arms, mills, and warlike implements have been found; in others the sole contents were pottery and debris. Many very interesting photographs have been taken representing the various industrial arts of the present Indians, the cliff dwellings of the ancient Pueblos and Mojaves; and the villages of the present day in which houses and even villages are built one on top of another, and are reached by long ladders, affording ample means of defense from the more predatory tribes. In addition to these pictures, others, and probably the most valuable of all, have been taken showing the ancient hieroglyphic rock-writing of the Indians. These have been placed in the hands of Prof. H. Allen of Philadelphia, who will undertake to decipher them and furnish a report. Many interesting facts have been collated in regard to the customs, religious ceremonies, traditions, and modes of living of the different tribes, and will be duly published. A valuable collection has been made of clothing and implements.

PHOTOGRAPHS AND PUBLICATIONS.

Mr. T. H. O'Sullivan, well known in connection with his work on the Fortieth Parallel Survey and Darien Expedition, was the photographer of the survey for the seasons of 1871 and '73; Mr. Wm. Bell of Philadelphia in

1872. The principal uses of photographs are for the topographers in obtaining an idea of the structural features, and for the geologist. Copies of photographs taken were forwarded to the Vienna Exposition, and some few have been printed for the use of the War Department; but as yet no general distribution has been made, although the views secured are in many cases of peculiar interest. The series are of the landscape and stereoscope sizes; the subjects are various parts of Utah, Nevada, California, Arizona, and New-Mexico. There is also a fine suite relating to the cañons of the Colorado, a selection of which, of the landscape size, will be brought before the public at an early day. In his annual report to the Chief of Engineers Lieut. Wheeler proposes to group the material at his disposal into the following forms:

1. Six quarto volumes.
2. One topographical and one geographical atlas, 19″ by 24″.

Vol. 1 is to include the general report concerning the expedition of 1871 and 1872, describing the country traversed, facts relating to its industries, the condition of present and extinct aboriginal tribes, &c. The text-matter will aggregate about 250 pages and 12 plates in illustration.

Vol. 2 will comprise the systematic report upon the longitude and latitude campaigns of 1871 and 1872 in their due order of sequence, and, if sufficiently delayed before going to press, can receive in addition the results from the field season of 1873, including the establishment of the observatory, and the more matured plan for a comprehensive system of astronomical determinations in the area west of the one-hundredth meridian. This volume will not exceed 250 pages, with but few additional plates.

Vol. 3. This volume will embrace the collected data from a very large number of hourly stations, and from meteorological record connected with altitude work, illustrated by various tables and plates. The text-matter will not exceed 50 pages. The tables and plates will complete a volume of moderate thickness.

Vol. 4 will contain the finished report of the geological work for the years 1871 and 1872. The sections will appear in immediate connection with the text. The size of this volume will not differ greatly from 225 pages, increased by a few geological plates.

Vol. 5. This volume, known to be the one upon "Palæontology," will contain a report and numerous plates of the new vertebrate and invertebrate fossils, for the years 1871, 1872, and 1873. The pages of text matter will not exceed 100, and the plates for illustrating new subjects probably not more than 50 or 60.

Vol. 6. This last volume of the series will render the matured results, for the years 1871, 1872, and 1873, in the different branches of natural history, the manuscript matter for which will call for at least 200 pages of quarto text and several plates.

The following maps have already been published for general distribution. In 1869, map of South-eastern Nevada, 1 inch to 12 miles; 1871, preliminary map, 1 inch to 24 miles; 1872, preliminary map, 1 inch to 24 miles. Advanced copies of Atlas publication are now ready. The finished work appears to be of the best that has been executed in this country. Besides the preliminary sheets, there will be four full atlas sheets presented as photographed, in crayon and in colors, accompanied by an index sheet and general topographical sheets, progress map, and a map showing the areas of drainage and the several basins of the territory west of the Mississippi. This edition will be made as large as the funds of the Survey will admit, but is not expected to meet the constantly increasing demand for trustworthy maps of this section of the country. It is intended to have one topographical and one geological atlas.

The barometric profiles gathered by the observers over the numerous routes of travel followed by the surveying parties are numerous. The limited working force of the office does not admit of their preparation for publication at present.

LOSSES BY DEATH—THE MURDER OF LORING.

Considering the fact that the several expeditions numbering each year from 125 to 200 men, have traversed these remote and inhospitable regions, where want of water, heat, danger from hostile Indians, etc., render the tenure of life often precarious, it may be considered remarkable that only six deaths have occurred, three of which were caused by the murderous hand of the Apache. In 1871, in the well-remembered stage massacre near Hickenburg, three members of the expedition of that year sold their lives dearly. One of them was young Loring, a writer of rare ability and promise; another, Mr. Hamell, chief topographer to the expedition; the third, Mr. Severn, a prominent member of the boat expedition of that year—all serious losses to the Survey. During this year two guides were lost in the Death Valley region, and it is supposed that they perished, no information to the contrary having as yet been received; at the time of their loss strenuous effort was made to discover them, but without avail. In 1872, in Paria Creek, Utah, one gentleman was drowned. During the past season Mr. William W. Maryatt, a most prominent astronomical observer, died at Bozeman, Montana. Other accidents inevitable in a life of so much toil, privation, and adventure, have occurred, but no others were very serious.

DETAILS OF ORGANIZATION.

To secure an economical and yet thorough prosecution of the work intrusted to his charge, it is proposed by Lieut. Wheeler that the unit of force in any given area shall consist of three field parties, with at least one officer in executive charge, one to be known as the triangulation party, the others as parties for collecting topographical, meteorological, geological and other data. These parties will carry on their operations in lines nearly parallel and make a thorough trigonometric connection over the entire district surveyed.

For the main astronomical work there will be three distinct parties; one to occupy the central and connecting station at Ogden, Utah, to be in charge of an engineer officer; a second to occupy points accessible by railroad communication within the area west of the 100th meridian, and a third lightly equipped for duty away from the railroad connections, yet at points where the telegraph has penetrated. The parties so organized would consist of

One officer, in charge.
Officers in charge of parties and as assistants.
Three civilian astronomical assistants.
Six civilian topographical assistants (including meteorological observation).
Four civilian geological assistants.
One naturalist and three assistants.
One photographer.

The following officers and civilian assistants have been connected with the Survey:

Lieut. Geo. M. Wheeler, Corps of Engineers, in charge.
Lieut. R. L. Hoxie, Corps of Engineers.
Lieut. Wm. L. Marshall, Corps of Engineers.
Lieut. S. E. Tillman, Corps of Engineers.
Lieut. Andrew H. Russell, 3d U. S. Cavalry.
A. A. Surgeon H. C. Yarrow, U. S. A., naturalist.
A. A. Surgeon J. T. Rothrock, U. S. A., botanist.
A. A. Surgeon C. G. Newberry, U. S. A.
Hospital Steward T. V. Brown, U. S. A., meteorological observer,
Civilian Assistant John H. Clark, astronomer.
Civilian Assistant Dr. F. Kampf, astronomer.
Civilian Assistant T. H. Safford, astronomer.
Civilian Assistant Wm. W. Marvatt, astronomer.
Civilian Assistant Louis Nell, triangulation and chief topographer.
Civilian Assistant Gilbert Thompson, topographer.
Civilian Assistant John J. Young, topographer.
Civilian Assistant Max Schmidt, topographer.
Civilian Assistant E. J. Sommer, topographer.
Civilian Assistant R. J. Ainsworth, assistant topographer.
Civilian Assistant J. E. Weyss, topographical draughtsman.
Civilian Assistant Charles Herman, topographical draughtsman.
Civilian Assistant A. A. Aguirre, topographical draughtsman.
Civilian Assistant J. C. Lang, topographical draughtsman.
Civilian Assistant G. K. Gilbert, geologist.
Civilian Assistant Prof. J. J. Stevenson, geologist.
Civilian Assistant E. E. Howell, geologist.
Civilian Assistant Dr. Oscar Loew, mineralogist and analytical chemist.
Civilian Assistant H. W. Henshaw, collector (ornithology).
Civilian Assistant John Wolfe, collector (botany).
Civilian Assistant George M. Keasby, collector (palæontology).
Civilian Assistant T. H. O'Sullivan, photographer.
Civilian Assistant C. D. Gedney, meteorological assistant.
Civilian Assistant F. M. Lee, meteorological assistant.
Civilian Assistant Bernard Gilpin meteorological assistant.
Civilian Assistant Francis Kott, disbursing clerk and assistant topographer.
Civilian Assistant Geo. M. Lockwood, property and purchasing clerk.

Among thoso who have assisted in elaborating the results of the Survey, especially the natural history, may be moutioned the following students of science:

Prof. S. F. Baird, Prof. O. C. Marsh, Prof. E. D. Cope, Prof. H. Allen, Prof. G. W. Tryon, jr., Prof. A. E. Verrill, Prof. T. P. James, Prof. S. T. Olney, Dr. G. A. Vasey, Mr. W. H. Edwards, Prof. Cyrus Thomas, Mr. R. H. Stretch, Mr. Theo. L. Mead, Baron Osten-Sacken, Prof. E. T. Cresson, Prof. P. S. Uhler, Dr. E. Coues, Prof. Wm. Holden, Dr. J. J. Woodward, Dr. Geo. Otis, Mr. W. G. Binney, Prof. Q. A. Allen, Prof. Asa Gray, Mr. H. Ulke, Mr. J. S. Milner, Mr. G. Brown Goode, Prof. H. A. Hagen, Mr. J. H Emerton, and many others.

THE EFFECTS OF ALCOHOL.

AN ADDRESS BY WM. A. HAMMOND, M. D.

INAUGURAL ADDRESS ON ASSUMING THE PRESIDENCY OF THE NEW-YORK NEUROLOGICAL SOCIETY—DELIVERED MONDAY, MAY 4—THE EFFECTS OF ALCOHOL ON THE NERVOUS SYSTEM, ILLUSTRATED BY EXPERIMENTS ON MEN AND ANIMALS.

The New-York Neurological Society met on May 4, at the College of Physicians and Surgeons. A large number of prominent physicians were present, among whom were Prof. L. A. Sayre, Prof. Willard Parker, Drs. Lente, J. C. Peters, D. B. St. John Roosa, Meredith Clymer, Murray, and others. The occasion was the delivery of the inaugural address on the "Effects of Alcohol," by Prof. William A. Hammond, as President of the Society. He was frequently interrupted by applause, especially when displaying the delicate test for alcohol in the liquor distilled from the brain, spinal cord, and nerves of a rabbit which had been fed on alcohol for several days and then killed. The following foreign physicians were elected honorary members of the Society: Drs. John W. Ogle, B. W. Richardson, G. Fielding Blandford, J. Hughlings Jackson, F. E. Anstie, J. Russell Reynolds, Henry Maudsley, and H. Charlton Bastian of London; Drs. T. Clifford Allbut and J. Crichton Brown of Leeds, Eng.; Drs. Labbadie Lagrave, A. Brière de Boismont, J. Baillarger, and G. B. Duchenne (de Boulogne) of Paris; Drs. Albert Eulenberg and C. Westphal of Berlin, and Dr. Thomas Laycock of Edinburgh. A short discussion followed Dr. Hammond's address.

THE ADDRESS.

GENTLEMEN: In returning thanks for the honor you have conferred upon me, in electing me to the presidency of the New-York Neurological Society, I must congratulate you on the auspicious awakening into life which the Society has exhibited. With a roll of members which in numbers and eminence would be worthy of any society in the country, it enters upon the self-appointed task of studying the science of medicine in all its relations to the nervous system.

INCREASING LIABILITY TO NERVOUS DISEASES.

If there is any higher scientific labor than this for a physician to perform I do not know what it is, and its importance augments daily with the advance of civilization and refinement, those great factors which do not stop at promoting man's intellectual and physical development, but which, as if every good thing must have its attendant evil, render him more liable to a class of diseases before which all others are of secondary rank. The thought which the statesman or the scientist elaborates from his brain, and which may be of momentous weight in the affairs of mankind, often leaves him who gave it birth with weakened or perverted mind, or the prey of some painful affection which of itself makes life a burden. The youth who, by ambition or the constant spurring of his teachers, is induced to make inordinate mental efforts to attain distinction, breaks down mentally and physically in the attempt, or else gains his object at a cost to his nervous system which is a dear price for any possible eminence he may thereafter reach. Not long ago I cut from a daily newspaper an advertisement of a school near this city, in which it was set forth as the sole inducement to parents to send their sons to the institution in question that at it "boys were waked up and set agoing." I thought then, and I often think now, of the anguish in store for some of the "dull boys" whom the teacher, doubtless with the best intentions, may "set agoing." The nervous irritability, the headaches, the sleeplessness, the confusion of ideas, the enfeebled body, the premature old age, the early death—not, perhaps, before the intervention of some organic disease of the brain or other part of the nervous organization—which a forcing system is apt to produce, are but a poor return for the doubtful honor of being "waked up and set agoing"—to say nothing of the lamentable failures attendant upon the process.

I might go on and invite your attention to many other ways in which civilization affects for good and for evil those organs which in their full development place man at the head of all created beings, but I am induced by the preëminent importance of the subject, to limit this address to the effects of alcohol upon the nervous system. I think I was one of the first to study the influence of alcohol upon man, from the standpoint of careful and exact experiment. In the year 1856 I instituted a series of investigations on myself which yielded definite results, and which placed in a very clear light the evils and benefits of the powerful agent under consideration. These related to the general influence of alcohol, and it may be well as a preliminary to the special subject of inquiry to consider, somewhat in detail, the subject of that study, and of the researches of others who have pursued a similar line of research. In so doing I shall draw largely from a former publication, not now readily accessible.

THE USE OF ALCOHOLIC BEVERAGES.

The propriety of the use of alcoholic liquors as beverages, the lecturer said, has been a subject of discussion for many years past, and is at the present time engaging a great deal of attention. Few, however, who have participated in it have considered this matter in its true light, and this is especially true of the advocates of total prohibition who have generally indulged in invection instead of argument, and whose facts are based mainly upon the immoderate use of the agents in question. No one can deny that alcoholic liquors, when imbibed in excessive amount, are not only injurious to the individual who takes them, but are also in the highest degree ruinous to society. We can even go further and admit that there are certain alcoholic compounds—such as the distilled liquors, brandy, whisky, rum, &c.—which, when taken habitually even in moderation by healthy persons, exert a more or less injurious effect, varying according to the quantity imbibed and the constitution and temperament of the individual. It is also undoubtedly true that even fermented liquors—ale, wine, porter, &c.—when used in excess, lead to results in many cases which are decidedly abnormal in character. And it is not to be questioned that the habits and mode of life of a great many persons

are such that not only is no stimulant of an alcoholic character requisite, but any such stimulant even when taken in very small quantity acts in a manner prejudicial to the well-being of the organism.

But it is illogical to argue from the excessive use of spirituous liquors by all persons, to the moderate use of some persons, and I shall endeavor to point out in what the difference consists, for that alcoholic liquors are not only beneficial to, but are actually required by certain classes of individuals, is not, I think, a matter for doubt.

The experiments of Dr. Percy have been often brought forward as proving something in regard to alcohol which was not true of any other substance. This observer injected strong alcohol into the stomachs of dogs. The quantity ranged from two to six ounces. Death followed, and upon examining the blood and brain for alcohol, it was always found. The presence of alcohol in the blood and brain, to those who look superficially or ignorantly at the matter has rather a horrible aspect; but when we know that there is no substance capable of being absorbed by the stomach and intestines which cannot also by proper means be detected in the blood and viscera, the subject loses much of its striking character. Dr. Percy used alcohol of 85° specific gravity, which represents a mixture containing about 80 per cent of absolute alcohol. As the strongest brandy contains but about 54 per cent of alcohol, the concentrated character of the liquor used by Dr. Percy is at once seen. In one case six ounces were injected into the stomach of a dog—a quantity amply sufficient to cause death in an adult man. The amount of essential oil present in onions is far less in proportion than the quantity of alcohol contained in the mildest wines, and yet we cannot eat one onion without this oil passing into the blood and impregnating the air exhaled in respiration with its peculiar odor. Doubtless the brain of a person who had dined heartily on onions would exhale the characteristic odor of the vegetable.

EFFECT OF DOSES OF ALCOHOL.

Many other physiologists have detected alcohol in the blood and viscera of animals after its injection into the stomach. I have several times performed experiments with reference to this point, and have never failed to recognize the presence of alcohol in the blood, brain, the stomach, expired air, and urine of dogs to which I had administered strong alcohol. But with liquors containing from 8 to 15 per cent of alcohol, such as the German, French, and Spanish wines, I have never been able to find it in the solids, though detecting it easily in the products of respiration. It is not to be doubted therefore that alcohol, like other substances, is absorbed into the blood and exerts its influence on the system through the medium of this fluid. Pure alcohol is a violent poison. In the dose of less than one ounce I have seen it cause death in a medium-sized dog, and many cases are on record of fatal effects being immediately produced in the human subject after comparatively small quantities had been swallowed. When diluted its effects are not so rapidly manifested, and from this form when taken in sufficient quantities the condition known as intoxication is produced. Previous to this point being reached the nervous and circulating system becomes excited, the mental faculties are more active, the heart beats fuller and more rapidly, the face becomes flushed, and the senses are rendered more acute in their operation. If now the further ingestion is stopped, the organism soon returns to its former condition without any feeling of depression being experienced; but if the potations are continued, the complete command of the faculties is lost and a condition of temporary insanity is produced. If further quantities be imbibed a state of prostration, marked by coma and a complete abolition of the power of sensation and motion follows. Such is a brief outline of the obvious symptoms which ensue upon the use of alcoholic liquors in considerable quantities. When taken in amounts less than are sufficient to induce any marked effect upon the circulatory and nervous systems, there is, nevertheless, an influence which is felt by the individual, and which is mildly excitatory of the physical and intellectual faculties. But there are other results which follow the use of alcohollic liquors which are not obvious to ordinary examination, and which, except in a general way, are not perceived by the subject himself.

We know that a certain amount of tissue is decomposed with every functional action of the organ to which it belongs. Just as steam results from the combustion of fuel, so thought results from the combustion of gray nerve tissue, motion from the combustion of muscle, and the force to secrete bile, from the combustion of the substance of the liver. We know very well that if fresh fuel is not supplied to the engine from time to time steam ceases to be formed, and the machine set in motion by it no longer works. The like is true of the body, and were it not for the formative processes which are continually going on whereby new material derived from the force is deposited to take the place of that which is consumed, death would very soon result. It must be distinctly understood, however, that ordinary food does not directly furnish any force inherent in the body, but that it must first be converted into flesh and brain and heart, etc., from the destruction of which organs the force peculiar to each is evolved. The process by which food is converted into tissue is called progressive metamorphosis, and that by which the tissue of organs is converted into force is called regressive metamorphosis.

USE OF ALCOHOL IN DELAYING THE DESTRUCTION OF TISSUE.

Now it is often advisable to diminish the destruction of tissue without, at the same time lessening the force which would otherwise be derived from its full continuance, or it may be necessary to obtain a great amount of force from an individual in a limited period. In alcohol we have an agent which, when judiciously used, enables us to accomplish both these ends, together with others scarcely less important, which will be alluded to more at length hereafter. The action of alcohol, in limiting the destructive metamorphosis of tissue, will be best illustrated by an example. Let us suppose that a workman laboring twelve hours a day upon a diet consisting of 10 ounces of meat and 16 of bread, finds that he loses weight at the rate of one ounce a day. Now in order to preserve his health and perhaps even his life, he must either take more food or he must lessen the waste of his tissues. Meat and bread are expensive, and he finds it difficult to obtain them; or, what is not at all improbable, the quantity that he eats is as much as he has any appetite for or can digest. The alternative presented to him is to work less. If he is his own master this would be an excellent way of getting rid of the difficulty. He would shorten the period of his labor to ten hours, and then, instead of losing weight, he would hold his own, or perhaps gain an ounce a day. But it may be that this alternative is not open to him—he must work 12 hours a day. In this condition of affairs he takes a mug of porter or a glass of wine, or, what would be worse, a dram of whisky, after his midday meal. He finds that he is pleasantly exhilarated, his vigor is increased, and

he labors on to the close of his task contentedly; and when it is concluded he is more cheerful and less fatigued than he has been before, when his day's work was ended. He returns to his home, and on weighing himself finds that he has lost but half an ounce. He repeats his experiment the next day; like results follow, and when he weighs himself he finds that he has lost nothing. The inference, therefore, is that the beverage he has imbibed has retarded the destruction of his tissues, and has itself aided in supplying the material for the development of the force he has expended in his labor. Now, it may be supposed that this is altogether a fancy picture based only upon assumption, like too many others which encumber science. In science, however, we believe nothing which is not demonstrated, and even then we do so provisionally, with the full understanding that if to-morrow new facts are brought forward which appear to be inconsistent with those upon which a favorite theory rests, and which are of greater weight, the hypothesis shall be abandoned without hesitation. Let us see, therefore, what evidence we have to support the view that alcohol retards the destruction of the tissues and supplies material for the generation of force. One of the products of tissue metamorphosis is carbonic acid. Many years ago Dr. Prout ascertained that after the use of alcohol the amount of carbonic acid excreted by the lungs was considerably reduced. Within the last few years other investigators have arrived at similar conclusions, after extending their inquiries to the other excretions of the system.

DR. HAMMOND EXPERIMENTS ON HIMSELF.

Desirous of ascertaining the facts for myself, I instituted a series of experiments calculated to determine the real value of alcohol as an aliment, or a substitute for aliment. Perceiving the difficulties attendant on such investigations when conducted on other persons, I performed these experiments on myself. They consisted of three series:

First: The influence of alcohol when the food was just sufficient for the wants of the organism.

Second: When it was not sufficient.

Third: When it was more than sufficient.

Four drachms of alcohol diluted with an equal quantity of water were taken at each meal. Not being an habitual drinker of alcoholic liquors in any form, the experiments were not open to the objection that they were performed upon a person hardened to the use of intoxicating beverages.

During the first series, when the food was of such a character and quantity as to maintain the weight of the body at its normal standard, I found, as the result of experiments continued for five days, during which time 60 drachms of alcohol had been taken, that the weight of my body had increased 226.40 ℔ to 226.85 ℔, a difference of .45 ℔. In the same period the amount of carbonic acid and aqueous vapor exhaled from the lungs, had undergone diminution, as had likewise the quantity of other excretions.

While these experiments lasted, my general health was somewhat disturbed, my pulse was increased to an average of 90 per minute, and was fuller and stronger than usual, and there was an indisposition to exertion of any kind. There was also headache and a sensation of increased heat of the skin. Later experiments, however, show that alcohol does not actually increase the heat of the body; so that the sensation of heat present after its use is one of those abnormal manifestations of nerve action met with in several other conditions of the system.

The inference to be drawn from these experiments certainly is that where the system is supplied with an abundance of food, and where there are no special circumstances existing which render the use of alcohol advisable, its employment as a beverage is not to be commended. But there are two facts which cannot be set aside, and these are that the body gained in weight and that the excretions were diminished. These phenomena were doubtless owing to the following cause. First: The retardation of the decay of the tissues. Second: The diminution in the consumption of the fat of the body. And Third: The increase in the assimilative powers of the system by which the food was more completely appropriated and applied to the formation of tissue. The quasi morbid results which followed are just such as would have ensued upon the use of an excessive amount of food or the omission of physical exercise when the body has become habituated to its use. If I had increased the amount of exercise taken there is no doubt there would not have been the undue excitement of the circulatory and nervous systems that was manifested.

The truth of these propositions is demonstrated by the second series of investigations, during which the food ingested was such as I had previously ascertained involved an average decrease in the weight of the body of .28 of a pound daily. Under the use of the alcohol not only was this loss overcome, but there was an average increase of .03 of a pound daily. The effects upon the exertions were similar to those which ensued in the course of the experiments of the first series.

But, unlike the first series, no abnormal results were produced in the general working of the organism. Digestion was well performed, the mind was clear and active, and there was no excitement of the circulating or nervous apparatus; in fact, all the organs of the body appeared to act with energy and efficiency. It is in similar cases, therefore, that the proper use of alcohol is to be commended; that is, when the quantity of food is not such as to admit of the due performance of such physical or mental labor as may be necessary, or (what amounts to the same thing) when the digestion or assimilative functions are not so efficiently performed as to cause the digestion and appropriation of a sufficient quantity of the food ingested to meet the requirements of the system.

In the third set of experiments, in which more food was taken than was necessary, the ill effects of the alcohol were well marked. Headache was constantly present, the sleep was disturbed, the pulse was increased in frequency and force, and there was a general feeling of *malaise.* I am sure that had the experiments of this series been continued I should have been made seriously ill. Notwithstanding all these abnormal phenomena, the body continued to increase in weight above the ratio which existed before the alcohol was taken, and the excretions were diminished in quantity. After such results are we not justified in regarding alcohol as food? If it is not food, what is it? We have seen that it takes the place of food, and that the weight of the body increases under its use. Any substance which produces the effects which we have seen to attend on the use of alcohol is essentially food, even though it is not demonstrable at present that it undergoes conversion into tissue. If alcohol is not entitled to this rank, many substances which are now universally placed in the category of aliments must be degraded from their positions.

A COMPARISON BETWEEN ALCOHOL AND ORDINARY FOOD.

Alcohol retards the destruction of the tissues. By this

destruction force is generated, muscles contract, thoughts are developed, organs secrete and excrete. Food supplies the material for new tissue. Now, as alcohol stops the full tide of this decay, it is very evident that it must furnish the force which is developed under its use. How it does this is not clear. But it is not clear how a piece of iron deflects a magnetic needle when held on the opposite side of a stone wall or a feather bed. Both circumstances are ultimate facts, which for the present at least must satisfy us. That alcohol enters the food and permeates all the tissues, is satisfactorily proven. Lallemand, Peron, and Duroy contend that it is excreted from the system unaltered. If this were true of all the alcohol ingested, its action would be limited to its effects upon the nervous system, produced by actual contact with the nervous tissues, but there is no more reason to suppose that all the alcohol taken into the system is thus excreted from the body than there is for supposing that all the carbon taken as food is excreted from skin and lungs as carbonic acid. It is not at all improbable that alcohol itself furnishes the force directly, by entering into combination with the first products of tissue decay, whereby they are again assimilated without being excreted as urea, uric acid, &c. Many of these bodies are highly nitrogenous, and under certain circumstances might yield their nitrogen to the construction of new tissue. Upon this hypothesis, and upon this alone, so far as I can perceive, can be reconciled the facts that an increase of force and a diminution of the products of the decay of tissue attend upon the ingestion of alcohol.

With these imperfect remarks relative to the general influence of alcohol upon the body, I proceed to the consideration of the special subject of inquiry, the effects upon the nervous system. The general action of a large dose is shown in the following experiment.

EXPERIMENTS ON DOGS.

I caused a dog to take into its stomach three ounces of strong alcohol diluted with a corresponding quantity of water. Immediately on receiving it the animal retired to a corner of the room and lay down. At the end of five minutes I endeavored to make it walk about the apartment, but it did so with evident reluctance, though up to this time the gait was not staggering. I should have stated that I detected alcohol in the expired air in forty-eight seconds after administering the liquid. After eight minutes the dog walked with some difficulty, and on carefully examining the gait I found that the posterior extremities were beginning to be paralyzed. This paralysis gradually increased, the gait became more and more staggering, and at the end of fourteen minutes the animal could no longer stand. The paralysis had now reached the anterior extremities.

Sensitiveness was still present, though evidently lessened in acuteness, loud noises were perceived, and the eyes were involuntarily closed when the motion of striking was made before them. The respiration was hurried, and the action of the heart was greatly accelerated. The pupils were at first contracted, but became dilated in about 15 minutes, and remained in that condition throughout the experiment. In 30 minutes the animal was in a state of profound coma. Sensibility even of the cornea was abolished, the limbs were in a state of complete resolution, the respiration was hurried, the heart beat rapidly but feebly, and the temperature had fallen from 101°, which it was before the ingestion of the alcohol, to 98.5°. The animal remained in a comatose state, and died in one hour and twenty-two minutes after the ingestion of the alcohol.

In this experiment the alchohol was administered in such a large dose that the period of excitation which generally follows in a few minutes was altogether prevented. In the following experiment the quantity was smaller, and the sequence of phenomena was more regular.

I introduced into the stomach of a large dog an ounce of alcohol diluted as before. Nothing occurred worthy of notice during the first few minutes. Then the heart was accelerated, as was also the respiration, and the pupils became contracted. Sensibility and the power of motion were unaffected. In twelve minutes the gait of the animal became uncertain, the limbs were lifted higher than was natural, and the body swayed from side to side, and occasionally strong efforts had to be made to maintain the erect position. The pupils were still contracted, and sensibility appeared to be intact. This condition lasted 22 minutes, and then the pupils began to dilate. The posterior extremities were so far weakened as to render locomotion impossible, and the sensibility of the posterior parts of the body were materially impaired. The respiration was very irregular. The pulse was still rapid, but weaker than at first. In a little less than an hour the animal was in a state of light coma, which lasted about 20 minutes. Recovery took place gradually, the phenomena of intoxication disappearing in an inverse order to their supervention.

Observation of the symptoms which ensue when alcohol in sufficient quantities is given animals shows that the condition of intoxication may, as Marvaud proposes, be divided into these periods or stages:

1. *Period of Excitation*—Uncertainty in the movements, acceleration of pulse and of respiration, contraction of the pupils.

2. *Period of Perversion*—Muscular paralysis, beginning in the posterior extremities, irregularity of pulse and of respiration, dilation of the pupils.

3. *Period of Collapse*—Complete paralysis of motion, anæsthenia, feebleness of the pulse and of respiration, stoppage of respiration and of the heart's action, death.

Now, I was desirous of knowing how much of this condition was due to the presence of alcohol in the brain, and how much to disturbance in the quantity of blood normally present in this organ. In other words, I wished to ascertain whether alcohol increased or diminished the amount of blood circulating within the cranium. For this purpose I performed the following experiments:

I trephined a dog and screwed a cephalohalmometer into the opening made by the trephine in the skull. I then administered an ounce of alcohol diluted as in the previous experiments. In fifty seconds I detected alcohol in the expired air; in four and a half minutes the respiration was accelerated, the action of the heart became more rapid and strong, and the pupils were beginning to contract, still there was no increase in the intracranial pressure, and I therefore knew that up to this time the amount of blood on the brain had not been increased. In six minutes and a half the dog's gait was staggering, and though his movements were uncertain there was no paralysis. The intra-cranial pressure was still unaltered.

The fluid remained stationary in the tube of the instrument till 17 minutes had elapsed. Then it began to rise slowly and with this increase in the intra-cranial pressure, paralysis of the posterior extremities supervened. As the amount of blood in the cranium became greater the paralysis extended, the pupils dilated and coma ensued. The return to sensibility and the power

of motion was attended with a diminution of the intracranial pressure, and was probably directly dependent thereon. I repeated this very instructive experiment twice with similar results. The deductions to be made from them are that the first symptoms which result from the ingestion of alcohol are due to the presence of this substance in the brain, while the later phenomena are in part at least the results of cerebral congestion.

DISEASES CONSEQUENT ON USING ALCOHOL.

The lecturer then proceeded to show the sequence of symptoms in man resulting from taking alcohol into the system. This consideration was more particularly applied to the effects upon the nervous system, showing the successive symptoms supervening with increasing amount of doses and describing the various stages from transitory excitement to complete intoxication. The effects of doses of alcohol given to animals were noted in detail. A valuable portion of the address was a discussion of the separate conditions of delirium tremens, and of the diverse methods of cure indicated by such difference; in the one class of case the free administration of alcoholic stimulants being necessary to save the patient, while in the other class of cases such stimulants would only aggravate the disease. The characteristics of chronic alcoholism were then discussed, and the various symptoms considered. The causes of the destructive effects of alcoholic liquors are then investigated and Dr. Hammond thinks it probable that their impurity adds to their baneful properties. He goes on to say: It is very certain, however, that chronic alcoholic intoxication very rarely, if ever, ensues on the moderate use of the light German or French wines, or of those made in this country, when they are not fortified by the subsequent addition of spirit, and that it is still less apt to ensue from the temperate use of malt liquors. The diseases of the nervous system, which, in addition to those mentioned, the excessive use of alcohol induces, are very numerous. In an address such as this, the most that I can do is simply to enumerate them. When I say that t of all other causes is most prolific in exciting derangements of the brain, the spinal cord, and the nerves, I make a statement which my own experience shows to be correct. I have already spoken of the remarkable affinity which alcohol has for the substance of which these organs are composed. Experiments hitherto have only related to the brain, but I am able to show you that the spinal cord and the nerves likewise absorb alcohol to equally great extent.

For ten days I fed a rabbit largely every day with bread soaked in whisky. In the course of that time the animal received nearly a pint of good Bourbon whisky, and beyond being somewhat stupefied, it did not appear to be seriously inconvenienced. At the end of ten days the animal was killed. I then removed the spinal cord and all the large nerves, and treated them separately with distilled water after cutting them into small pieces. They were then thrown upon a filter and strongly pressed. The three separate portions of liquid extract were then distilled several times, and finally treated with quicklime and again distilled. In these, the test tubes, I have the products. This marked A is the distillate from the brain; this marked B is from the spinal cord, and this C, which, as you notice is scarcely more than a drop, is from the nerves.

ALCOHOL IN THE SPINAL CORD AND NERVES EXHIBITED.

The odor is of itself almost sufficient to show that each consists of alcohol, but we have in the solution of bichromate of potash in sulphuric acid, a more trustworthy test. To show you how delicate it is, I take a test tube containing a little of the test and pass into it a current of air slightly impregnated with the vapor of alcohol. As you perceive the characteristic reaction, the production of a green color at once ensues.

Now, I take the test tube marked A which contains the distillate from the rabbit's brain and I allow a drop or two of the test liquid to mingle with it. A dark green color is at once produced, and it is rendered visible to every one in the room as I disturb the mixture with a little distilled water.

Next, I take the tube marked B which contains the liquid derived from the spinal cord. It is smaller in quantity than that from the brain, because the cord is much smaller than the brain. I pour on it a drop of the test liquid, and again you see the bright emerald green color is formed.

Finally, we examine the distillate from the nerves. The quantity here is extremely small, but the test shows it to be alcohol. So far as I know alcohol has never been before detected in the spinal cord or substance of the nerves of animals which had been fed with it. Neither has it been found in these organs in man. That it is there, however, in alcoholics, there can be no doubt.

We are now prepared for the long list of diseases and disorders of the nervous system produced by the excessive use of alcohol. The catalogue is made up from my note-books, and is based on cases occurring in my private and hospital practice:

OF THE BRAIN.

Cerebral congestion.
Cerebral hemorrhage with its consequences, apoplexy and paralysis.
Meningeal hemorrhage.
Cerebral thrombosis.
Softening of the brain.
Aphasia.
Acute cerebral meningitis.
Chronic cerebral meningitis.
Abscess of the brain.
Multiple cerebral sclerosis, one of those diseases of which tremor is a characteristic symptom.
Every variety of insanity, including general paralysis.

OF THE SPINAL CORD.

Spinal congestion.
Antero lateral spinal sclerosis.
Posterio-spinal sclerosis (Locomotorataxia).

CEREBRO-SPINAL DISEASES.

Epilepsy.
Chorea.
Multiple cerebro-spinal sclerosis, another of those affections characterized by tremor.
Athetosis, a remarkable disease which I was the first to describe, and which is now well recognized both in this country and in Europe. The case on which my description was based was one in which the patient was in the habit of drinking sixty glasses of gin daily.

OF THE NERVES.

Anæsthesia.
Paralysis agitans.
Neuralgia in all situations.
Neuritis.
Neuro-sclerosis.

It will be noticed that sclerosis or hardening is a condition of all parts of the nervous system which alcohol probably often produces. It is doubtless the result of the direct action of alcohol on the nervous tissue.

In addition to being the exciting cause of many diseases of the nervous system, alcohol probably predisposes to various others in which no direct relation can be traced. Neither does its action stop here, for the descendants of persons addicted to the excessive use of alcohol are liable to various disorders of the nervous system.

WHAT CONSTITUTES EXCESS.

Doubtless you have observed that my remarks relative to the evil consequence of alcoholic potations have been based upon the excessive use. It would be only fair for you to ask me what constitutes excess? And if you did, I should answer that, in the abstract, I do not know, any more than I know how much tea or coffee any one of you can drink with comfort or advantage, how many cigars you can smoke without passing from good to bad

effects, how much mustard on your beef agrees with you, and how much disagrees, or how much butter you can eat on your buckwheat cakes. In fact I do not know that you can use any of these things without injury. For to some persons tea and coffee and tobacco and mustard are poisonous. Every person must, to a great extent, be a law unto himself in the matter of his food. No one can *a priori* tell him what and how much are good for him. A single glass of wine may be excess for some individuals, while to others it fills a rôle which nothing else can fill. That alcohol even in large quantities is beneficial to some persons, is a point in regard to which I have no doubt; but those persons are not in a normal condition, and when they are restored to health their potations should cease. I have seen many a weak, hysterical woman drink a pint of whisky or brandy a day without experiencing the least intoxicating effects, or even feeling excited by it. The exhausted tissue has seemed to absorb it with an energy as though it were its one thing craved, and recovery has been rapid under the use when all other means have failed. I have seen strong men struck down with pneumonia and fever, and apparently saved from the grave by brandy or other alcoholic liquors. I have prevented epileptic seizures by its moderate use. Neuralgic attacks are often cut short by it, and sometimes entirely prevented. It has been efficacious in catalepsy, and in tetanus it is one of the best antidotes to the bites of poisonous serpents, as I have repeatedly witnessed: in the convulsions of children from teething and other sources of reflex irritation it is invaluable; in the spinal irritation to which women, and especially American women, are so subject nothing takes its place, and in certain forms of gastric dyspepsia it must be given if we wish to cure our patients.

DANGER OF EXCITING ALCOHOLIC THIRST.

You know all this as well as I do, and you know that I have by no means mentioned all the diseases in which so far as our knowledge goes, alcohol in some form or other is the sheet-anchor of our hopes. I would not like to be cut off entirely from the use of alcoholic liquors in my practice, and yet I often try to do without them, for I am fearful of exciting a thirst which will not stop at my bidding. Still, when they are clearly indicated I give them without self-reproach, feeling that I have done my duty, and that I am no more responsible for the consequences of any after abuse than I should be for the shipwreck of a child whom I had in good faith, and with the object of contributing to his welfare, sent on a voyage to Europe. I would not send my son to Europe to be educated if I could in all respects educate him equally well in this country; neither would I prescribe alcoholic liquors if I could do without them. I know that I am digressing from my subject, but in view of the great importance of the whole matter, I ask your indulgence for a little further wandering.

With reference to the moderate use of alcoholic liquors, it must be remembered that we are not living in a state of nature. We are all more or less overworked; we all have anxieties, and sorrows, and misfortunes, which gradually in some cases, suddenly in others, wear away our mind and our bodies. We have honors to achieve, learning to acquire, and perhaps wealth to obtain. Honors and learning and wealth are rarely got honestly without hard work, and hard work exhausts all the tissues of the body, and especially that of the nervous system. Now, when a man finds that the wear and tear of his mind and body are lessened by a glass or two of wine at his dinner, why should he not take it? The answer may be, Because he sets a bad example to his neighbor. But he does not. His example is a good one, for he uses in moderation and decorum one of things which experience has taught him are beneficial to him. And why should he shorten his life for the purpose of affording an example to a man who probably would not heed it, and who, if he did, is of less value to society?

None of us defend dram-drinking. It is a vile, a pernicious practice, but the instinct that drives men and even women to it is human, and we must take it as it exists, just as we are obliged to recognize other instincts fully as vile and pernicious. The inborn craving for stimulants and narcotics is one which no human power can subdue. It is one which all civilized societies possess. Among the earliest acts of any people emerging from savagery is the manufacturing of an intoxicating compound of some kind, and one of the first things a colony establishes is a grog-shop. It was, as Dr. Chambers remarks, "an awful outburst of nature" when out of 500,000 men who took the pledge in the United States 350,000, according to *The Band of Hope Review*, "broke it;" and he very pertinently asks, "Have the same proportion ever broken vows of chastity or any other solemn obligations?"

But if we cannot overcome the instinct by prohibitory laws, we can regulate it and keep its exercise within bounds. My own opinion is that the best way to do this is by discriminating legislation in favor of wines and malt beverages and against spirituous liquors. I would make it difficult to get whisky and at the same time easy to procure beer, and I would likewise offer every encouragement to the growth of the vine and the hop. Experience has shown that total prohibition while failing to a great extent in practice, drives men and women to opium and Indian hemp, substances still more destructive to mind and body than alcohol.

DIPSOMANIA OR METHOMANIA.

Another point seems to require notice. There is a condition, a form of insanity it may be, known as dipsomania, or, more properly methomania. It is described as consisting in an irresistible impulse to indulge in alcoholic liquors. Doubtless there are individuals who, while recognizing the injury which excessive indulgence in alcohol inflicts upon them, are, in a great measure, powerless to control their morbid appetite. At one time they might easily have refrained, but frequent yielding, and perhaps also the direct action of alcohol on the brain, have so weakened their volitional power that restraint is well-nigh impossible. Probably many who pass for ordinary drunkarks are in reality methomaniacs. Indeed, I suppose there are very few of those who are habitually more or less intoxicated who in their more sober moments will not lament their inability to abstain, and curse the feebleness of will and the strength of the appetite which keep them drunkards. For all such the lunatic asylum is the proper place, so long as they commit no outrage on the persons or property of others. If they plunge into crime punishment should follow with as much certainty as for sober criminals. As for confiding in the honor of such persons and allowing them to range at large while nominal residents of an inebriate asylum, I regard it as the uttermost kind of folly. What would we think of the wisdom and prudence of a superintendent of a lunatic asylum who would trust to the honor of a patient who had previously attempted suicide, and allow him to go at large on his pledge not to kill himself? And yet this is essentially the nature of the discipline at inebriate asylums. I have

never seen a drunkard cured by this kind of restraint, and I have seen many who have told me how readily, while patients in such institutions, they found liquor enough to keep up the desire for more.

Gentlemen of the Neurological Society, I am afraid I have greatly trespassed on your patience, and yet I have very incompletely fulfilled the task I set for myself. To consider the subject of this address with even moderate fullness of detail would require more time than I have to give and much more than I would venture to ask of you. Many of you are, I am sure, much more capable of doing it justice than myself, and I leave it in your hands, confident that it will be elaborated with a completeness worthy of its importance.

As to the influence of alcohol over other parts of the body, and many of its more important relations to the system at large, I have not even alluded, as they did not come within the scope of the limits I have adopted.

There is much for us to do in the department of neurological medicine, to which from time to time your attention will be invited. There is not one among us who cannot contribute an idea of value to the rest. I ask you therefore to show your loyalty to the Society and your devotion to the cause of scientific medicine by freely interchanging such suggestions as may occur to you in the daily exercise of your profession. Remember that facts should come before theories, and that though an hypothesis may suggest a practice, hypothesis by itself is the dreamiest of scientific rubbish. With your aid and forbearance I hope to discharge to your satisfaction the duties of the honorable office to which I am called by your partiality.

THE DISCUSSION.

REMARKS OF DR. WILLARD PARKER.

Dr. Willard Parker, who was present during the delivery of the essay, was invited by Dr. Hammond to give his views upon the subject discussed, and responded as follows:

I should not be willing to take up much of the time of the Society, and should simply say I am very happy of this opportunity of being present. I have heard your address with very great pleasure, and in most points I should agree with you, though in some points I should differ. There is one point I am extremely glad to see brought up before this Association. I do not propose to speak evil of this matter of temperance. There are many men of many minds, and many women, too. We will simply let them have their way. The temperance movement of the last half century has undoubtedly accomplished a great deal. Its purpose has been to accomplish it simply upon the basis of moral suasion, and then they have intended to influence legislation to a certain extent. I say nothing about that, either as opposing it or advocating it. There is no subject before the public mind to-day so important as that of the use of alcohol, not only in our own country, but in all countries. In the northern regions we find more of the stronger distilled liquors used than in the low latitudes. There of course they are using their light wines, unless you come to Germany, where they are drinking beer. The starting point appears to be, first, What is alcohol? I fully concur with you as to its being a poison. Others have experimented upon the subject besides yourself, and all seem to have arrived at the same conclusion.

But because it is a poison gives no one a license to say that it may not be used with the opposite effect at proper times. It is one of the most valuable medicines we have. but as to the advantage or disadvantage of every corner shop here or in Brooklyn practicing in this matter and dealing out this liquor, that is another question, and we shall leave that for the present. The important point here is the scientific aspect, and on that is the stand our professional brethren should take.

The question we have to decide is, first, "What is alcohol?" and then the great question, in the second place, which you, Sir, have handled so ably, is "What does it do to you or to me?" The point is as to alcohol —its use, and what it does to the individual. I am not prepared to agree entirely with the proposition you advocate so strongly, that alcohol produces force. I do not understand it so, and I understood you to say you did not account for it, but simply assumed it does it. It may do it and it may not. I am not ready to assent to that proposition; I am not prepared to say I shall not assent. My views have greatly changed of late years in regard to this matter. When I first took up this subject, if a patient came under my charge pretty well worn down by drink, I knew I had an exceedingly bad subject to manage. One of our first questions is, what kind of a constitution does the individual bring to us, and we recognize, if he is a toper, that he is a bad subject.

I have followed on and followed on, and I have reached a point like this. I don't see how we can make food out of it; but what place can we give it in the dietetic department? My feeling is that no individual system in health is benefited by the introduction of alcohol, but it is not always easy to decide what is health precisely. But when there is feebleness in the system, from age or sickness, and food is to be taken into the stomach, the stomach requires power to convert it into the proper condition to become proper, nourishing blood, I have conceived that, in a person taking that substance into the stomach, by the use of a certain quantity of alcohol, in the shape of wine, or beer, or brandy, the food will, with the presence of the brandy, have a perfect assimilation. In that way it is entitled to a position. I have a chimney in my house, for example, which does not draw very well. That resembles the old man. I put in a little kindling wood, in addition to the other fuel, and by that I get a good fire and am extremely comfortable. I don't know about it exactly, but I learn from the experiments of these gentlemen that when alcohol is introduced into the stomach it arrests the process of digestion. About the nitrogenous substances I am in doubt, but I fancy it does not do a great deal with the starchy substances. In persons who eat a great deal of meat and drink alcohol, it arrests the process, and after a time the stomach will evacuate itself, and the pieces of meat come up hardened. When the alcohol is taken into the stomach before the food is taken in, it acts upon the pepsin and hardens that. Some French physicians say it passes through without being changed, like an atom which gets into the eye; when it is removed it is unchanged, and the eye quickly recovers. Then other persons are very strongly of the opinion, and I think Dr. Duprey proves, that only a limited quantity of it passes away, that a portion is retained in the stomach. What becomes of that portion? That is not yet settled in my mind. I want to see this subject carried forward in this Society, and if possible to assign to alcohol its true, legitimate, effective position in the materia medica in the world. It has been proved by workers in all kinds of employments as well as by those who were traveling in high latitudes, that their health failed, so that even

the insurance companies have been looking to it. There is a fearful cutting short of life and usefulness by the habitual use of alcoholic drinks. I mean wine and the whole list. If there is any difference between wine and rum. there is an article in each which produces the effect. The other ingredients are like the clothing we have on; it may be Winter or Summer clothing. When you come to the matter of beverages, I suppose, as about 80 parts of the body are water, water is the only beverage on earth that repairs the system. You take the milk that we get from the mother's breast. It is only water we have, though there is also sugar and casein. I am exceedingly anxious to see this go on. I will talk with you some other time about the cure of inebriates, for I don't agree with you there. We want a military management of these fellows, as we have at West Point. They are to be re-educated, and moved at the tap of the drum.

Dr. Hammond—If you can treat them as soldiers and lunatics, I think you can cure them. I don't say that chronic alcoholism is absolutely incurable. I say the present inebriate asylums will not cure them. That is, according to my experience.

Dr. Parker—The inebriate asylums have been very great instructors. I find there are three classes of inebriates. One class is made up of respectable gentlemen—young men or the heads of families, who have yielded to a social feeling, and by that have got to a certain point where they cannot live without liquor. Their will power is gone. There is another class where the desire is inherited, and who have their fits once a month, or once a year. In all creation, no human power can restrain them. I have known it to come on from the individual's going into an apothecary-shop and picking up a cologne-bottle and smelling it. Then we have a third class, many of them raised in our cities, the children of those who have suddenly come to wealth, children who have no true education; who feel that having money they must get the worth of it. The only thing that can be done for them is to have a place for incurables, and place them there in order to protect their families and friends.

REMARKS OF DR. J. C. PETERS.

Dr. J. C. Peters—I have but few remarks to make. I have paid but little attention to the subject of late; but 30 years ago—in 1844—I made many post mortems on the cadaver of drunkards, and in many of those cases I was surprised to find the small amount of injury done to the stomach where alcohol had not been used in large quantities; but when taken to excess the appearance was certainly as great as that referred to by Dr. Lente as being hemorrhagic. The amount of hemorrhage found in the mucus membrane of the stomach, bowels and bladder, is certainly extensive, and the injury was very great. I regard the effect of alcohol in larger quantities upon the stomach as very little short of a corrosive poison. The shock is almost equal to that of a surgical shock, and is very much like it. It occurs in the course of a very few hours; and I presume that shock falls upon the great solar plexus, although I presume the injury to the mucous membrane of the stomach itself is very great. We can find a smal quantity of alcohol in the peritoneum; we will not find it lower down in the bowels, as it is absorbed very rapidly.

Experiments, Mr. President, similar to those which you have performed, in which alcohol has been detected in the brain, are numerous. Christison and others have extracted a quantity of alcohol sufficient to be burned, as we burn it usually in a lamp. I might say a few words upon the point which you have especially noticed in connection with your account of my experiments, namely, the great firmness of the brain of one who has used alcohol to excess. It was a fact which struck me very forcibly. We know that alcohol will coagulate albumen. The brain substance is composed in a great degree of albuminous substances, and it is the great affinity of alcohol for the albumen which, I presume, is the grand reason why the brain is so often found in this hardened condition. We know also that alcohol is a stimulant; that it stimulates the stomach and improves digestion. It will increase the quantity of the gastric juice which is thrown out, and this operation of the stimulant will help many a weak stomach to digest food which would otherwise lie in an undigested mass. Alcohol in excess causes the pepsin to be precipitated, and digestion is stopped. I have been exceedingly cautious in advising alcohol for any sick person, especially in the case of women—nervous, hysterical women—because I am so fearful of establishing a habit of using it; but when I do prescribe it, it is for the purpose of food. I never allow alcohol to be taken on an empty stomach under any circumstances. I prescribe it in fixed quantities, as I would arsenic, and when its work is finished I order it stopped, as I do any other medicine after it has accomplished the object for which it was intended to be administered. I was also, at the time I speak of, 30 years ago, struck with the infrequency of tubercular diseases in drunken persons, and those who died from an excessive use of alcohol. The system of giving alcohol in this disease has gradually worked its way into the profession until whiskies and spirits of all varieties is almost an established treatment in diseases of a tubercular character.

Dr. Alonzo Calkins thought that in making these experiments with alcohol an excessive quantity had been used, as much often as two ounces of pure alcohol. The result would be expected to be different if one half-ounce were used. It is analogous to taking an immoderate quantity of food in the stomach; a portion is absorbed, while the greater part passes off indigestion, and only a part of it is appropriated. So it might be with alcohol; a small part of alcohol might be appro priated, but the greater part would pass away.

REMARKS OF DR. MEREDITH CLYMER.

Dr. Meredith Clymer, who was present by invitation, said: Dr. Parker put this question, "What becomes of the portion of the alcohol retained in the system ?" in view of recent experiments showing that a portion of the alcohol taken into the system passes out, and a portion remains in. Now, that question is connected with the question of food. This is an interesting subject to us all. Dr. Hammond stated that he could not explain it. and it seems to me that these experiments are decidedly in opposition to the conclusion that alcohol is food. If it were food it would be assimilated; and yet we find by these novel and admirable experiments which Dr. Hammond has shown us, that after a certain time it is retained in the nervous tissues. I only wish these experiments had gone further, and that he had submitted to the same tests the other organisms of the body—the stomach, liver, &c.—and I am quite confident he would have found the same results—that they would have appeared in those tissues just the same as in the brain. The experiments are of great

value particularly in regard to these hemorrhages—one of the most common of post-mortem results. What have these observations of osteology shown; that the portion of alcohol retained in the system acts directly upon the nerve tissues, and upon what tissues? First, upon the cellular tissue; then adventitious tissue is gradually substituted for the healthy tissue. We find this takes place in the stomach, the liver, and the brain, and that probably accounts for the hardening process. The first post mortems which I made were in 1843. Some were men who had died from chronic alcoholism. In several cases the odor of alcohol was very strongly perceived on the removal of the cerebral membrane, and its presence in one if not in two cases was shown positively by chemical tests. The change in tissue takes place by the direct poisoning of this tissue. Then comes the effect of mechanical pressure, as well as the vital action of this poisoning upon the essential tissue of these organs. That is a granular fatty degeneration. We have therefore a twofold result of fatty degeneration, in the first place, and secondly, not only a hardening but a substitution of tissue. It has been shown that there is an inflammation upon the surface of the brain and surrounding the membrane, as in the ordinary cases of general paralysis. We have known of this fatty degeneration, but it was not until recently that we know that this extended to the nervous centers.

Remarks were also made by F. D. Lewis, M. D., of Cold Springs, N. Y., and Dr. Roberts Bartalow of Cincinnati.

THE TRANSIT OF VENUS.

PREPARATIONS FOR OBSERVATION BY DIFFERENT NATIONS.

A BRIEF ACCOUNT OF WHAT OTHER NATIONS ARE DOING—ORGANIZATION OF THE UNITED STATES COMMISSION FOR THE WORK—DETAILS OF THE ARRANGEMENTS FOR THE EXPEDITIONS.

[FROM AN OCCASIONAL CORRESPONDENT OF THE TRIBUNE.]

WASHINGTON, May 7.—A review of the preparations which different nations are making, including our own, for observing the coming transit of Venus, will be found somewhat gratifying to our national vanity. England has selected five stations to which she will send parties. She has now the ship Challenger inspecting islands in advantageous locations in the South Indian Ocean. There will probably be two stations in the Sandwich Islands, one of which will be at Woahoo, for the purpose of observing accelerated ingress (that is, for taking observations at a station which, from its geographical position, will be among the first where the approach of the planet to the sun's disk is visible), and two others at Kerguelen and Rodriguez Islands, for retarded ingress (that is, for observations from a station among the last from which the approach can be perceived); another at Auckland for accelerated egress, and a fifth at Alexandria for retarded egress (those stations being among the first and last where the departure of the planet from the sun can be observed); the two parties at the Sandwich Islands being considered as occupying one station.

The estimates submitted by the Astronomer Royal were for the Woahoo detachment, $12,500; for Rodriguez and Kerguelen's, $10,000 each; Auckland, $5,000, and Alexandria, $3,750; making a total of $41,250. A grant of $52,500 was made in May, 1869. Troughton and Simms make the instruments, and Dent the clocks for all the parties. The Cambridge Observatory lent two, and Mr. De la Rue one, of the telescopes to be used. One of the equatorials was the one formerly used by Admiral Smythe.

ENGLISH METHODS AND INSTRUMENTS.

The buildings for the instruments are substantial structures, stout wooden framework covered with weather boarding, and roofed with zinc and roofing felt Each instrument has a separate building, those for the transit instruments being 10 feet square, with walls six feet high. The alt-azimuth huts are nine feet hexagonal, with a hexagonal dome on circular frames, with six rollers, to permit their being turned with the opening in the roof to any part of the heavens. The buildings are made portable by being constructed in sections, which are connected together by bolts and nuts. For the transit instruments massive Portland stone piers will be provided, with foundation slabs. For the alt-azimuth, stone pier caps only will be sent out, leaving the piers to be provided on the spot. The sources of their personnel are the officers of the Royal Artillery, the students of the Naval College, and some private individuals who are now undergoing a preliminary drill at Greenwich. Photographic observations will be made at Peshawar in Northern India, and Lord Lindsay has equipped a party at his own expense to observe the transit from the Island of Mauritius.

There was a belief current among astronomers that photography could not be used where the photographs were afterward to be subjected to such rigorous measurements as are necessary to give us a more accurate value of the solar parallax than we now possess; or in the words of our own Mr. Rutherfurd, " The photograph of the sun will have a greater or less diameter by many seconds of arc, according to the energy of the rays which have produced the image; and this discrepancy may be produced by a change in the aperture, in the length of the time of exposure, in the transparency of the atmosphere, in the hour of the day, or in the sensibility of the chemicals." Accordingly, the position of Venus on the sun's disk must not be measured from the limb of the sun, but from its center; and it is now found that the probable error of measuring the position of Venus, as given by Prof. Hall, will be about twelve-hundredths of a single second of arc, which is about the one-fourteen-hundredth of the whole diameter of the sun, which is certainly within the probable error of an observation, by the eye, of a contact.

As soon as it became evident that photography would be an important auxiliary, England ordered of Mr. Dallmeyer five photo-heliographs, built under the direction of Mr. De la Rue, whose object-glasses, four inches in diameter, give an image of the sun about half an inch, which is afterward enlarged to four inches in diameter. The whole apparatus, unlike the American photographic apparatus, is moved by clock-work, and mounted in the usual equatorial style; and for the purpose of defraying the expenses of the photographic apparatus $25,000 additional has been appropriated.

RUSSIAN, FRENCH, AND GERMAN PREPARATIONS.

Russia will occupy twenty-seven stations, stretching across her Siberian possessions, about 100 miles apart, from Kamschatka and from the Black Sea. The equipments of the individual parties will not be as complete as either the English or American, and it is the design to determine the geographical position of the stations by the geographical survey, which will use a line of telegraph through Siberia to Nicolaevsk, to determine

the longitudes. An appropriation of $52,500 has been made to defray expenses.

The French Commission before the Franco-Prussian war recommended to the Bureau des Longitudes the occupation of St. Paul's Island, New-Amsterdam, Yokohama, Tahiti, Noumea, Mascate, and Suez. Since the close of the war the subject has again been taken up, the French Academy has applied to the Government for aid, and under the head of "Public Instruction" a provisional appropriation of $20,000 has been made to be expended under the direction of a commission whose head is Alphonso Martin. Lately this appropriation has been increased by one-half.

Germany has decided to furnish four parties for heliometric observations—one in Japan or China, and the others probably at Mauritius, Kerguelen's, and Auckland Islands.

Other countries have made preparations on smaller scales, even New-South Wales granting $5,000, and, under the direction of Mr. Russell, establishing three parties, at Sydney, Eden, and the third in the Blue Mountains, about 50 miles west from Sydney. Most of the European nations sending parties to comparatively unknown regions have attached a naturalist, and the expeditions in this way will contribute to the natural sciences as well as to astronomy. It would have been desirable to have had a naturalist attached to the United States parties had the funds of the commission having the matter in charge justified the necessary outlay.

AMERICAN PREPARATIONS.

In 1871 the United States Congress appointed a Commission to expend such appropriations as might be made for the observations of the transit of Venus. It consisted of the following members: Rear-Admiral B. F. Sands, Superintendent U. S. Naval Observatory; Prof. Joseph Henry, President National Academy of Sciences; Prof. Benjamin Peirce, Superintendent U. S. Coast Survey; Prof. Simon Newcomb, and Prof. Wm. Harkness, U. S. Naval Observatory. The Commission selected Admiral Sands for chairman, and it is to his warm sympathy with the cause of astronomical science, and to his executive energy in properly bringing the matter before our Government, that the thanks of American scientists are due: for with inadequate provision for defraying the large outlay necessary, we might have given reason for the doubt of De Tocqueville which Prof. Tyndall quoted to us: "The future will prove whether the passion for profound knowledge, so rare and so faithful, can be born and developed so readily in democratic societies as in aristocracies. As for me, I can hardly believe it." The letter of Admiral Sands, March 5, 1872, asking for $150,000 to be expended in three annual installments of $50,000 each, received the indorsement of the Secretary of the Navy, and the appropriations asked were granted by Congress. It was resolved to employ both photography and eye-observations of contact, and after discussion as to the various photographic methods proposed, it was decided to form the image of the sun on the sensitized plate by means of a fixed photographic lens, five inches in diameter, and having a focal length of about forty feet, reflecting the sun's light from one surface of a plate of glass, the plate being moved by clock-work, so that the rays of the sun, after being reflected from the plate, will always strike the photographic lens in lines parallel to the line connecting the center of the reflecting plate, the center of the fixed lens, the center of the sensitized plate. To carry out the methods of observation by the eye and ear, it was resolved to provide five-inch equatorials, furnished with micrometers, by which the distance between the two cusps of Venus could be accurately measured, as Venus entered upon and left the sun's disk.

The principal work of carrying out the views of the Commission has devolved upon those members of it connected with the Naval Observatory. After most of the arrangements had been completed, there was a change in the members of the Commission, caused by the retirement of Admiral Sands from active duty in the Naval Department on account of advanced age, and the resignation of the Superintendent of the Coast Survey. Both these gentlemen were retained as honorary members, and Rear-Admiral C. H. Davis, the present Superintendent of the Observatory, and Capt. Patterson of the Coast Survey, were added to the Commission.

OUR STATIONS AND INSTRUMENTS.

Eight stations were selected, and so far as is now known will be occupied as follows: Vladivostok in Siberia will be occupied by Prof. Hall of the Naval Observatory, with probably Mr. O. B. Wheeler of the Lake Survey as assistant. Pekin will be occupied by Prof. J. Watson of Ann Arbor. The Coast Survey party under Prof. G. Davidson, who retains Mr. O. H. Pittmann as first assistant, will occupy Nagasaki. Capt. Raymond of the United States Engineers will occupy Crozet Island, with Lieut. Tilman as assistant. Lieut.-Commanders Ryan and Train, U. S. N., will occupy Kerguelen's Island. Prof. Harkness of the Naval Observatory with Mr. L. Waldo of Columbia College, N. Y., as assistant, will occupy Hobart Town. Bluff Harbor, New-Zealand, will be occupied by Prof. C. H. F. Peters of Hamilton College, N. Y., assisted by Lieut. Bass of the U. S. Engineers. Mr. E. Smith with Mr. Scott as assistant, both of the Coast Survey, will occupy Chatham Island to the extreme east. Three photographers will be sent with each of the above parties, and all the members of the various parties are subject to the discipline of the Navy during their absence. All of the Southern parties and one of the Northern are now in Washington in active preparation for the transit.

Each party is supplied with an equatorial, a transit instrument so modeled as to be used as a zenith telescope at will, a clock, with chronograph, two box chronometers, a set of engineer's instruments, a magnetometer, a photographic outfit, a chest of carpenter's tools, supplies, &c.; and will carry with them three wooden huts, put up in sections, to be pinned and screwed together when they are needed by the observers. The instrumental outfit has been designed and constructed under the immediate supervision of Prof. Harkness, to whose accurate knowledge of the capabilities of portable instruments much of the success of the expeditions will be owing. Mr. Alvan Clark constructed the equatorials, the photographic apparatus, and the optical parts of the transit instruments, of which the other parts were made by Stackpole Bros. of New-York. The clocks were made by E. Howard of Boston, and the chronometers by J. S. & D. Negus of New-York. The magnetic instruments were made by Mr. Kahler of Washington.

The Southern parties will be conveyed to their destination by the U. S. third-rate sloop-of-war Swatara, under the command of Capt. Ralph Chandler. The Swatara usually carries nine guns, but will carry but one, a 60-pound Parrott, until she is through with the expeditions. She is now fitting up at the Brooklyn Navy-Yard. It is expected she will sail from New-York the last of May. Her route will include the Cape of Good

Hope, thence eastwardly, leaving parties at the stations named. While waiting for the observers to determine their geographical positions and to observe the transit, she will be employed in exploring some of the neighboring islands, or doing work for the Commission. Each party is provided with magnetic apparatus sufficient to determine the magnetic elements of their own station. Negotiations are now in progress having in view the telegraphic determination of the longitudes of the Northern stations, and Hobart Town, with possibly New Zealand, of the Southern stations. The longitudes of the isolated islands will be determined both by means of chronometers, and by observations of star occulations by the moon. Prof. Henry Draper has the management of the photographic part of the expeditions now well under way; and in his work he has derived much benefit from the early efforts of Mr. Walker, photographer to the Treasury Department, to provide only efficient photographers from among the numerous applicants for positions on the various parties.

THE ORIENTAL SOCIETY.

MEETING AT BOSTON.

A SESSION OF MORE THAN USUAL INTEREST—AN ETHIOPIC MANUSCRIPT PICKED UP IN THIS COUNTRY—PHŒNICIAN INSCRIPTIONS IN BRAZIL A FORGERY—CRITICAL EXAMINATION AS TO AUTHENTICITY, &C., OF THE OLD TESTAMENT—THE HEART, LUNGS, AND LIVER IN DIFFERENT LANGUAGES.

[FROM AN OCCASIONAL CORRESPONDENT OF THE TRIBUNE.]

BOSTON, May 21.—Be it known to such as are not acquainted with the facts, that the American Oriental Society was born in the year 1845, that it is therefore twenty-nine years old; that it has no less than 150 members, mostly college professors, literateurs, distinguished philologists, and explorers in the Oriental and the antique—all, however, wearing our American garb, and most of them speaking English without accent. Further, that it has a library in New-Haven of about 4,000 volumes, which is yearly enriched by exchanging its own publications with those of nearly every similar society in the Old World; that it is also in possession of several important Sanscrit inscriptions, and a valuable Greek inscription from Antioch, which is referred to the third century before Christ, not to mention a sufficient amount of trash which always constitutes the lumber of such societies. It is perhaps necessary to add—for nobody would discover it except by accident—that the Society holds two meetings each year, one generally at New-Haven in the Fall, and the other at Boston in the Spring.

The need of this explanation is found in the fact that this Society moves with muffled oars, and is enabled to steal back and forth from New-Haven to Boston without contributing in the slightest to the noise which exists in the vulgar world. A further explanation is that, like all polyglot societies, it is the perfect horror of reporters, and that the horror is to some extent reciprocal. Under these circumstances, it was not surprising that the annual meeting held May 20 in the rooms of the American Academy of Science and Arts, at the Athenæum, was small in point of numbers, and that it received little or no recognition from the daily press. Yet every other man of the twenty who were thus ignored was of scholarly or intellectual prominence, and the meeting was one of the most interesting the Society has held. I send you some crumbs that fell from the table.

There were present Prof. Edward E. Saulsbury, President of the Society, and formerly Professor in Yale College; Dr. Ezra Abbott, Recording Secretary of the Society, and Professor in Harvard Divinity School, one of the most accomplished biblical and classical scholars in the country; the Rev. Dr. A. P. Peabody, Professor of Moral Science in Harvard University; Prof. C. M. Mead of Andover; the Rev. Dr. Rufus Anderson, Secretary of American Board of Foreign Missions; the Rev. Selah Merrill of Andover, Prof. W. D. Whitney of Yale, Corresponding Secretary, known not only to all Oriental and linguistic scholars in this country and Europe for his original contributions to literature, but especially known to your readers as the correspondent of THE TRIBUNE with the Hayden expedition last year; the Hon. J. H. Trumbull of Hartford, the oracle on all matters relating to our Indian languages, and whose Yankee skill in untying philological knots seems almost intuitive; Dr. Wm. Hayes Ward, editor of *The Independent*, who, as an original explorer in Hebrew and Phœnician, never fails to contribute to the interest of the Society; the Rev. J. W. Jenks: Dr. Nathaniel Hoppen of Cambridge, Prof. Frederick Gardiner of Middletown, Conn.; Hon. Stephen Saulsbury of Worcester; Prof. Felix Adler, Professor of Oriental Literature in Cornell University, one of the youngest and boldest contributors of the Society; Dr. Dimmock of Quincey; Prof. Charles Carroll Everett of Harvard University, who has brought a rare genius for philosophy to the interpretation of the Oriental religions; T. S. Perry of Cambridge; and Ex-Mayor Russell.

The routine business of the Society was soon dispatched. The officers of the preceding year were all reëlected. The Rev. H. F. Jenks of Boston; Prof. Felix Adler of Cornell University; Charles P. Otie, Professor of Modern Languages in the Massachusetts Institue of Technology; Howard Osgood of Brooklyn, N. Y.; and Isaac S. Hall of New-York, were elected members. The necrology of the year shows the loss of Charles Astor Bristed, Prof. Alphens Crosby of Salem, J. F. Meline of Brooklyn and Dr. Francis Mason, and called forth appropriate remarks from Prof. Whitney, the Rev. Dr. Peabody, the Rev. Dr. Anderson, and Dr. Ward.

WHO HAS LOST A MANUSCRIPT?

Prof. Whitney read the correspondence since the last meeting. A letter from the Rev. Charles H. Brigham of Ann Harbor, Mich., may result in finding the owner of a stray manuscript picked up last November on the premises of the Michigan Central Railway by a laborer. The manuscript is made of thin, soft parchment, in the form of a roll, and, according to Mr. Brigham's description, is a genuine Ethiopic document. It was conjectured by some of the members that the manuscript might have been obtained in Abyssinia by some one who accompanied the late English expedition.

The Rev. Mr. Trowbridge from Turkey gave an interesting account of arrow-headed inscriptions in the vicinity of Aintab, to which place he is about to return to establish a new college. In monasteries in the Taurus Mountains he had seen some very beautiful manuscripts in the ancient Armenian language. He expected great good would come from the establishment of the college, which might be regarded by the people as a repository for inscriptions and manuscripts. Mr. Trowbridge was encouraged by the Society to explore ancient ruins in the vicinity of his field of missionary labor, and to send

home at the Society's expense whatever might be valuable.

The paper following was by Prof. Fiske P. Brewer, on the Greek inscriptions found near Beirout, which was published in the second number of the proceedings of the American Palestine Exploring Society.

Prof. Mead of Andover read a paper on the use of the Hebrew *Kol* with negatives. In Hebrew a universal negation is expressed by the use of this word (meaning all) with a negative particle. There is no compound word corresponding to our word "none" and "no." Grammarians have referred to but one passage in the Bible of a partial negation (Num. xxiii, 13). Prof. Mead undertook to examine all places in the Bible where *Kol* occurs with a negative. He examined 326 passages. Only six of these can be called cases of partial negation, and all but one of those occur in sentences in which *Kol* is made definite.

The remaining papers of the morning session were on the Chinese *Sien* as Constellations, by Prof. Whitney; on Certain Phœnician and Greek Inscriptions from Cyprus, by Dr. Ward; on the Hamath Inscriptions with remarks on Lenormant, also by Dr. Ward. Copies of these inscriptions were shown to members. Dr. Ward also remarked on a supposed Phœnician inscription found in Brazil purporting to have been left by mariners. He was entirely convinced that it was a forgery, though a very ingenious one. It was dated in the time of King Hiram, which would require a more antique form of letter than that which was used. Palæographically, it would hardly be older than the fifth century B. C. For an inscription so old as this purports to be, the state of preservation was remarkable, and another evidence of the forgery. Dr. Ward thinks this forgery may be an incident of the struggle between the Masons and the priests in Brazil, King Hiram being invoked by the former in this way to give antiquity to their claim.

The Society then took a recess from 1 to 2 o'clock. The afternoon session was more lively than that of the morning, and was distinguished for the bold, straightforward, and scholarly, yet courteous way in which Prof. Adler ventured to arraign previous methods of studying and interpreting the Old Testament. I select his paper from among others, because of its more popular and elementary character, and because, though presented entirely from a philological and philosophical point of view, its bearing on theology gives it a special interest to all classes of readers.

METHODS OF STUDYING AND INTERPRETING THE OLD TESTAMENT.

Prof. Adler, who spoke entirely without notes or manuscript, said: It seems to me that nothing is of so much importance in the range of Semitic study as a clear notion with regard to the chronology of the Old Testament. The question whether a certain part of the Old Testament was written sooner or later than some other part has a significance not only in the study of the Bible, but in Egyptology, in Indian studies, and in many different branches of research. Whatever can throw light upon it ought to claim the attention of scholars. The Professor then gave what his studies in Germany especially qualified him to present—an account of the status of opinion in regard to the exegesis of the Bible in Germany at the present day.

The view which obtained in the beginning of the century was that the book of Genesis, more especially, consisted of a number of fragments joined together by the hand of a later editor, but essentially fragmentary in its character. That was the hypothesis of Vater. He noticed the different accounts of the creation, the difficulties in the history of Joseph, certain other contrary stories and anachronisms, and solved the difficulty to himself by accepting the opinion which Geddes had pronounced before him—that we have here a collection of fragments bound together in a single volume. Astruc introduced a more plausible hypothesis to explain the same phenomena. He regarded the book of Genesis, and, later, the Pentateuch, as the work of a compiler, believing that Moses had before him certain old documents, from which he had selected as the occasion seemed to warrant. This represented Moses in the light of a modern editor, and this view did not gain the allegiance of scholars. Ewald, in denouncing this opinion, put forth his own view, that the prevalence of different names of the deity (Elohim and Jehovah) in different parts of Genesis, was due not to the fact that different authors had written different parts, but was to be attributed to the different terminology which the same author thought it proper to employ on different occasions. He endeavored to show that the names Elohim and Jehovah had their peculiar significance. Tuch's Genesis, a new edition of which has been prepared by Merx, with a prefatory postscript of his own, brought prominently before the world the supplemental hypothesis. Accepting the fact that the hands of different authors were to be seen in Genesis and the Pentateuch, he held that there was one principal record, and to this supplements had been made by the editor and compilers of the books. This hypothesis found favor with many until the appearance of Hupfeld's work created a new phase in Biblical criticism. He made divisions which have been essentially adhered to. First, the main distinction between Elohist and Jehovist; again, with regard to the first of those, a new division into first and second Elohist. We would then have first and second Elohist and the Jehovist. In order to combine these records of different authors he supposed an editor. In addition to this the book of Deuteronomy required its separate author. Here then, including the editor of Genesis, were five persons, to which was added later a sixth, who had joined the book of Deuteronomy and a great part of Joshua to the Tetrateuch. Although important additions and changes have been made, the basis of the work has not been altered.

Boemer has made some important additions to this theory. He tries to explain different portions of the Bible from the fact that they originated in the Kingdom of Israel or of Judah. Graf applies the theories that have been applied to Genesis to the whole Pentateuch. He calls attention to a statement, which, if true, would be of the greatest importance in establishing the chronology of the Old Testament. He endeavors to show that contrary to the received opinion, the laws of Leviticus are not older than those of Deuteronomy, in which there appears nothing of circumcision, nothing of a day of atonement. Graf then endeavors to prove that the laws of Leviticus were inapplicable to any state of things which had existed in Israel before the time of the Babylonish captivity. He therefore fixes their date after the time of the exile.

What Prof. Adler especially desires to call attention to, is the fact that Graf deduces his propositions in a historical and archæological manner; that he enters into the subjects of the books and endeavors to show from general historical principles what can have been prior and what later. This change of method is of great importance. Hitherto literary peculiarities have taken

precedence. But in the case of a book like the Old Testament, containing as it does the relics of the literature of a people, it always seems to be a very precarious thing to deduce important theories from peculiarities of style. The difference in style, excepting the later Chaldaic and the more degenerate style of Ezra, Daniel, and even Ezekiel, is not sufficiently pronounced to warrant important results. An exception may be made as to the change of meaning which is traceable in the history of words—a change which reflects the character of the time and the conditions of life. A good example is incidentally given by Geige in his Urschrift. The word *tsadek* (righteous), he thinks, came to mean a mighty man—a man of violence—in which sense it is used in Isaiah xlix., 24.

It seems to me, said Prof. Adler, that for all the labor that has been expended upon the criticism and exegesis of these books, comparatively scanty results have been obtained, scantier than the nature of the books or the high attainments of the men who have devoted their lives to this study should warrant. There is such diversity with reference to the composition of the books of the Bible that it shows how little the study of this chief part of Semitic literature has become a science. Thus, for instance, with regard to the second Psalm, two prominent critics differ as regards the time of its composition to the extent of an interval of a thousand years. Ewald attributes it to the time of King Solomon; the other critic, whose name escapes me, puts it a thousand years later. Another evidence of disordered criticism is found on the 118th Psalm, 10th verse. A certain modern critic thinks he must find the peculiar circumstances under which these words were written ("In the name of God I will cut them off"), and he tells us with a very sober face that it refers to Alexander Jannæus subduing the Idumeans and forcing them to enter the Jewish community. He would translate, "In the name of God I will circumcise thee."

With Graf I think we have entered the proper path. The proper way seems to be to study the archæology of the Jews—which is being done pretty well—and to study the principles of mental development and the laws of national development, and to attempt to apply them in the particular field which we cultivate ourselves. I do not see why we should hesitate to acknowledge that the greater has risen from the smaller, and the higher from the lesser. I do not see why we should hesitate to acknowledge that idolatry was practiced. The prophets tell us themselves that it was practiced, and I cannot conceive why we should be more scrupulous—if to deny it be more scrupulous—than the prophets themselves.

Now, wherever we have met with idolatry, we have found mythology. It would be strange indeed, if we should have idolatry in the Old Testament and not some relics of the ancient myths. Indeed, it would almost be derogatory to the character of prophecy to suppose such a thing, else where would be the superior nobleness and strength of conviction of the greatest of antiquity if they had not to combat the same difficulties among the Israelites as were found elsewhere?

I do not refer at length to the vast learning and splendid results of Geige. His labors in the field of Biblical criticism are of such great importance, and can be so little appreciated without an intimate knowledge of the later writings of the Jews, that I reserve a more extended discussion for some future occasion.

In conclusion, let me direct your attention to one thing more. It is the fact that the text of the Old Testament was preserved with such scrupulous care by the people, that mistakes made in multiplying manuscripts were perpetuated as well as the correct portions: and we are able now to detect many of these. In the 15th chapter of Exodus, for instance, I think it is clear that the 12th verse ought to be in the place of the 11th; the connection is then properly preserved. So Psalm lxxi., 3, is to be corrected according to Psalm xxxi., 4 (3d verse in Hebrew), and to be read *Beth Mezudot;* the mistake occurring from improperly dividing the lines into words. So in Job xxxiii., 21, "My flesh melts away so that it is no more seen, and my bones are dry; they are not seen;" the word for "seen" in Hebrew is *Ra-ah;* which probably, by the change of a letter, was substituted for *Ravah*, which means to "drink," and which, if restored to the text, makes the parallelism complete; thus, "My bones are dry because they have no drink."

An example of a mythological construction is the story of Achan. Any one who has ever read carefully the Book of Judges must be aware that the mental and social condition of the people there set forth does not permit us to suppose that a reign of pure monotheism preceded. The fact that Jephtha offers his daughter without any blame attaching to himself; the fact of a Levite serving as priest to an idol, gainsay this. The whole character of the book shows that the time of Joshua, as it is represented to us, is rather the picture of a golden age, rather an idealization than a historic period in the realistic sense of the word. Into this period the ideals of the people were projected. The word Achan at first sight seems to have no explanation in Hebrew. But we find that the name of the valley was Amek-Achor, "valley of wailing." We are elsewhere told that in this valley of wailing there was a huge heap of stones. The people had no explanation for this mass of stones thrown together. They sought one. Everybody who has traveled in mountainous countries knows how peculiarities of the country are personified. There, then, was a mass of stones as one element for a tradition; the "Valley of Wailing" furnished the other element. To connect these was simple enough. Amek-Achor was the valley of a man named Achor. The stones were easily associated with the Jewish custom of stoning offenders, and the priests, therefore, laid hold of this fact to impress upon the people the necessity of offering their booty to the synagogue by telling of the punishment which had befallen Achor. There seems to be some verification of this theory in the fact that in 1. Chron. ii., 7, this man Achan is actually called Achor. We should be apt to receive this very readily if it were a Greek myth. As it is a Hebrew myth I doubt whether it would be received as such. I do not offer it with any degree of certainty, but only as one of the means by which those who study the Hebrew books in the light of philology may in time arrive at conclusions which would be more certain than those of to-day.

DISCUSSION ON DR. ADLER'S PAPER.

Dr. Gardiner of Middletown came immediately to the rescue of the inspirational theory; but his good taste prevented him from precipitating a theological discussion. He simply rose in protest, and said he supposed that to take any view opposed to this would be to take theological grounds, which would be out of place. He supposed Prof. Adler had meant to present this view not as the prevailing view of German thinkers, but as the view of some.

Prof. Adler by no means wished to say that that was the generally received opinion in Germany; but it is the received opinion among the majority of writers, if

he mistook not Not certainly what he stated in the latter part of his remarks. In what he had presented as more or less generally received he would pause with Graf. He owed to Gerge the view that the ideas of the later period were projected into the former part of Jewish history. He would mention Delitsch as a conservative, differing from those views, but conceding the fact that the Pentateuch was written by Moses while he asserted that there was a Mosaic kernel and a Mosaic spirit.

Dr. Hopkins of Cambridge, who by the way is a sound Episcopalian, had listened to Prof. Adler with a good deal of satisfaction. He thought the discussion entirely proper. As a literary society, it was interesting and instructive to have views of different schools of thought brought before them. He differed from Prof. Adler in a good degree, but was none the less gratified at his clear and learned exposition of a view which is taken by an important school of modern learning. Still he thought some of Prof. Adler's conclusions rather hasty and perhaps rash. He suggested that conjectural emendations of authors, whether sacred or profane, was at the present day one of the great sources of dissatisfaction and error.

HEART, LIVER, AND LUNGS, ETYMOLOGICALLY CONSIDERED.

The Hon. J. H. Trumbull read an interesting and original paper on "The Names for the Heart, Liver and Lungs." The drift of the paper, which exhibited great ingenuity as well as extensive research, was to show the primary and secondary ideas which are associated with the names for the superior viscera not only in the North American Indian languages, but in the European and Asiatic languages. The Chippewa *Opan*, Illinois *Apani*, denote the lungs of a man; and Chippewa *Abanini*, literally "lung man," one who is a slave or servant. To say that a man was "all lungs" was to call him an inferior being. The expression "He is lungy," means he is a dolt, he has no wit. It is so in the Sioux; *Chagu*, lungs, *Chaghuka* a fool. In Arrapahoe, *Kuna*, lungs; *Kunanit*, cowardly.

Take the word "pluck" in English. It has the double meaning of that which is plucked or pulled altogether from the outside of a slaughtered animal: it is then used for courage, spirit, energy, as to pluck up heart or spirit. Heart in the ancient Egyptian is a word denoting mental status and activities; so in the Hebrew and in the Chinese mental constitution; also desire and appetite. Of the latter the liver seems to have been regarded as the peculiar seat. The character for the heart, *sin*, enters into the composition of a great number of words. He found 1,097 beginning with the radical *sin*. In the Indo-European family we have everywhere the reference of the moral character, the will and emotions to the heart. By the Orientals the liver was regarded as the seat of the passions and the animal nature of man. Some Chinese writers make the lungs the seat of righteousness and the liver the seat of benevolence; mere vigor and courage seems to have been assigned to the gall.

The derivation of the French, Spanish, Portuguese, and Italian names of the liver (foie, higado, figado, figato,) are from the figs with which the Romans used to stew the livers of geese. "It might pass," said the doctor, "for an etymological joke if it were not a fact."

In Chinese, "his lungs and liver" expressed his inmost thoughts. In many languages lungs are named for their lightness. The old naturalists held that the smaller the lungs in proportion to the body the greater the swiftness of the animal. Hence large lungs began to be associated with dullness, sluggishness. The notion of contempt attached to the lungs comes from this notion of lightness, lacking weight, then from the notion that the larger the lungs the slower the animal; and among the American Indians, from the fact that the lungs were the last part and the least worthy part, which was given away when an animal was divided at a feast. The least important guest received the lungs.

Papers were also read by Prof. Whitney on the *Anusvara;* by Prof. Saulsbury, an elegant translation from the German of Schnaase on Mohammedan art in its relations to the ideas of Islam; and by the Rev. Mr. Jenks on the identity of the Hebrew Shaddai and the Egyptian Suti. The Society, after passing a vote of thanks to the American Academy for the use of its rooms, adjourned to meet in New-York on the 30th of October.

SAFETY AT SEA.

IRON VESSELS THAT WILL NOT SINK.

PRINCIPLES OF CONSTRUCTION OF OUR OCEAN STEAMERS—METHOD ADOPTED IN NAVAL VESSELS AND THE GREAT EASTERN—THE CELLULAR OR DOUBLE SKIN SYSTEM.

Iron shipbuilding was made possible by Cort, who in 1784, or thereabouts, introduced his discovery for the manufacture of plates and bars of iron by the use of rolls. In the process of growth of a new science of construction some errors, some misconceptions are inevitable. When iron was first used in shipbuilding, the attempt was made to follow in the metallic construction the plan so long adhered to with wooden ships. In them, ribs of wood are set up attached to the keel at the bottom, and held together at the top by the transverse deck beams. On this plan the earlier iron ships were, and now are, to a certain extent, constructed.

MODE OF CONSTRUCTION.

Iron ribs took the place of the wooden ones, and the sheathing of planks, caulked and covered with copper, was replaced by plates of iron rivited to the ribs. As the experience of the shipbuilders increased and as science was furnished with the data of previous experiments, the transverse construction, or that which more closely imitated the old wooden ships, was found to be less efficient than that known as the longitudinal system. This latter consisted in running along the inside of the ship, parallel with the kelson, strong side kelsons, placed a few feet apart, and meeting or running into one another at the bow or stern, as the ship's lines become fine at either end.

The kelson, it will be understood, is almost like the keel, the difference being that it is placed inside of the ship instead of outside. It runs directly over the keel and is bolted to it. Side kelsons are similar, running parallel with the main kelson. To strengthen these longitudinal beams, angle iron was worked transversely over them, forming a system of ribs which added to the strength, while requiring less iron than was formerly used in the transverse system.

Looking downward into the bottom of a vessel thus constructed, we should see that it was divided into a series of square compartments. Over these were placed plates which, parallel to the skin or outer covering of the ship, formed a second skin, one ship built inside of the other, as it were. Thus by connecting every sixth or eighth transverse rib with the bottom, the whole of the

ship's bottom and sides was divided into a number of small water-tight compartments or cells, any one, or almost any number of which, could be filled with water without endangering the ship's ability to float. Two thicknesses of iron had to be pierced before vital damage could be done to the vessel. This is called the "cellular construction," and ships built in this way are said to have a "double bottom" or a "double skin."

GENERAL APPLICABILITY OF THE DOUBLE SKIN.

Though best applied to vessels with the longitudinal system of framing, the cellular or double bottom can be used in ships having transverse frames. This construction was used for vessels of war, where great strength and security were required, but by John Scott Russell it was introduced in the Great Eastern, the first merchant steamer having a double skin. It probably saved the great ship in a moment of peril.

The cellular system must not be confounded with the water-tight compartments or bulkheads used in all our transatlantic steamers. These bulkheads are iron divisions running directly across the ship from side to side, and from kelson to decks, dividing the vessel into as many separate transverse compartments or divisions, any of which may by some accident become full of water without endangering the safety of the vessel. The construction of the bulkheads may be illustrated by a long hall or room divided by walls into a number of sections, communicating by doors. Shut these doors, and any of the divisions might be filled with, say smoke, without the others being penetrated. Their distance apart should be about equal to the ship's beam. The idea originated with the Chinese in their trading vessels, and was introduced in England by Mr. Williams about 1839, or a few years earlier, in very nearly the present form.

The recent loss of so many iron vessels has given a foundation to the idea that their strength is inferior to that of the old wooden steamers, or at least that they are more liable to sudden and serious disasters, and that less rough usage will unfit them as efficient sea-boats. What safeguards are provided against accident in our ordinary transatlantic steamers? They are all provided with water-tight bulkheads, which divide them into seven or eight sections, and which are supposed to be a sufficient safeguard against any ordinary calamity, but they are not built on the cellular system, with double skins from the keel to the water line.

SAFETY OF CELLULAR CONSTRUCTION.

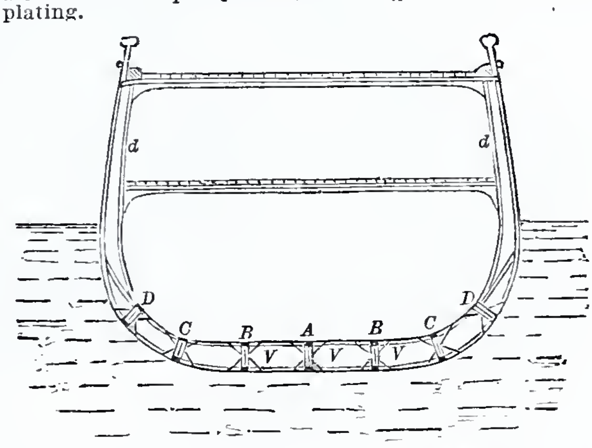
By this latter mode of construction we actually reduce the chances of accident to a fraction, for we place one ship inside the other, and we make it necessary that both the inner and outer skin be pierced before we have recourse to our water-tight bulkheads, which under all circumstances are the last resort. The facts of the case are these: Our iron vessels, as at present built, are not as strong as the old wooden ones. Less force is required to pierce a hole, either by a rock or by a collision, through the plating of our iron steamers than was required to break through the seven or eight inches of solid wood used in the vessels of a few years ago.

Though the desire of the owners of steamships to make money has thus induced them to depart from the sound practice by building single-skinned ships weaker than their modern predecessors, it is no argument against the use of iron in the construction of vessels. The more we study the science of shipbuilding the more we learn to appreciate the fact that a vessel is to be regarded simply as a beam or girder, subject to different strains, depending upon the way she happens to be supported by the waves, whether in the middle by one wave, or whether by two waves, one at each end. Thus, in calculations, we treat a ship, and as the result of our figures we find that the strength must be placed in the bottom and in the top of our vessel; that the resisting power of the upper deck to crushing and tensile strains must be about equal to that of the ship's bottom. It will be observed in looking at an iron beam or girder that the strength is placed at the top and bottom. In this case the dictates of both science and practice have been observed. But, in opposition to this system, which has been proved to be correct, our present iron vessels grow gradually weaker from the bottom up till the upper deck is the weakest of all. Now strength could be insured in the bottom, which should at least equal, if not more than equal, that of our wooden ships; but to do this would require that the iron be much thicker than at present, and the weight would be increased in a greater proportion than the strength.

STRENGTH INCREASED IN PROPORTION TO WEIGHT.

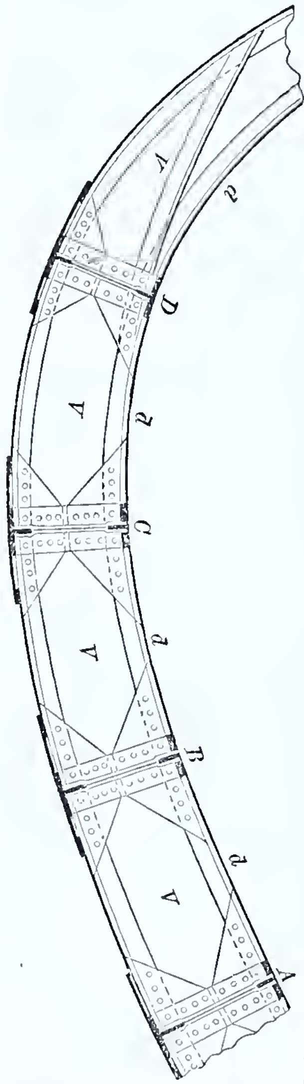
Here comes in the value of the cellular construction with the double bottom; the weight is increased in proportion to the strength, and we obtain a result which for safety is far ahead of that secured by the mass of wood in the wooden ships. If the longitudinal system of framing is adopted, we shall also have a gain as to weight over the transverse system, and this amount of iron saved can be used in making the upper deck cellular also, as was done in the Great Eastern, thus making our vessel conform closely to the structure of a girder or beam, the result which we wish to obtain.

Let us see whether the cellular system has done anything to prevent vessels sinking. When the Great Eastern was entering the Sound she struck on a rock and perforated her outer plating. The damage was serious; seven holes were made, one 85 feet long by four or five wide. Transverse bulkheads as put into a ship would not have saved her; she would have sunk so rapidly that her passengers could not have reached the upper deck, had she not had a double bottom three feet inside of the one pierced, which being intact kept her afloat and would have continued to do so had she desired to make the voyage home again. She was repaired in New-York without being removed from the water by Mr. E. S. Renwick. Other cases can be given of naval vessels with the cellular construction which have been saved after almost equally severe damage to their outer plating.



Two diagrams will more clearly explain the construction of vessels built with the longitudinal system of framing, and with double bottoms. No. 1 shows a cross section of such a ship, and No. 2 is an enlarged view of the bottom from the keel to the water line. The parts lettered A B, C, D, are the longitudinal frames running the length of the ship, the parts marked d are the plates of the inner skin meeting the outer plating at the water line, on a point a little above it. The gusset pieces are worked in to strengthen the construction, the ribs of angle iron, as shown by d, also giving stiffness to the sides and serving as bracings to the longitudinals A, B, C, D.

It will be seen how comparatively safe must be a ship with all the water-tight cells V, V, V. The mere piercing of the outer shell, sufficient in itself to sink vessels of the present build, will not injure a ship built in this manner. The distance apart of the inner and outer plating should be between two and three feet, preferably the latter. This method of construction can be used either for steamers or sailing vessels, and in either case the protection is of the most perfect nature which can practically be used.



Enough has been said clearly to demonstrate the superiority of cellular ships. Whether the danger menacing them be a rocky coast, an approaching vessel, or an opening in the seams of the plating, so long as we have two thicknesses of iron between us and the water we can rest in the comfortable assurance that no ordinary calamity can cause our vessel to become suddenly unseaworthy. In advocating the adoption of the cellular construction for the transatlantic steamers, it is not proposed that an experiment be tried, but simply that the views of some of the most eminent shipbuilders of the world be adopted. John Scott Russell has, both in his practice and in his great work on shipbuilding, advocated most strenuously the adoption of double bottoms in vessels of any considerable size. Sir William Fairbairn considers that the cellular construction is the only method which presents the maximum of safety, and he advises its adoption. Others equally eminent in all matters pertaining to shipbuilding predict that the longitudinal framing combined with an inner skin will enable iron ships to meet safely the dangers which now are almost certain to cause their destruction. Haste to be rich alone delays the adoption of these improvements. The law may eventually do much, but more can be done by the public—by travelers and shippers of freight not insured above its value, by simply refusing to patronize those lines which do not hold out as an inducement, at least for passenger traffic, the safety afforded by ocean steamers with double bottoms, which shall be a little better than egg shells. Thus can the pocket nerve be touched of those who, with the light of science and experience, for the sake of a saving in first cost, send every year many thousands of souls across the broad Atlantic in ships whose construction violates the known rules of safety.

ERRATA.

Page 36, col. 1, line 7: For "Tacson," read *Tucson.*
Page 37, col. 1, line 28: For "G. H. Long," read *S.* H. Long.
Page 37, col. 1, lines 31-32: For "Lieuts. J. Allen and Schoolcraft," read Lieut. J. Allen and *Dr.* Schoolcraft.
Page 38, col. 2, line 25: For "O'C Ord," read *O. C.* Ord.
Page 38, col. 2, line 33: For "Timpson," read *Simpson.*
Page 40, col. 2, lines 47 and 54: For "Kanal," read *Kanab.*
Page 41, col. 2, line 31: For "Isidro," read *Ysidro.*
Page 41, col. 2, line 53: For "Memhres," read *Mimbres.*
Page 43, col. 2, line 37: For "Jase-Utes," read *Go-si-Utes.*
Page 44, col. 2, line 2: For "Hickenburg," read *Wickenberg.*
Page 44, col. 2, line 5: For "Hamell," read *Hamel.*
Page 44, col. 2, line 6: For "Severn," read *Salmon.*
Page 44, col. 2, line 83: For "Kott," read *Klett.*

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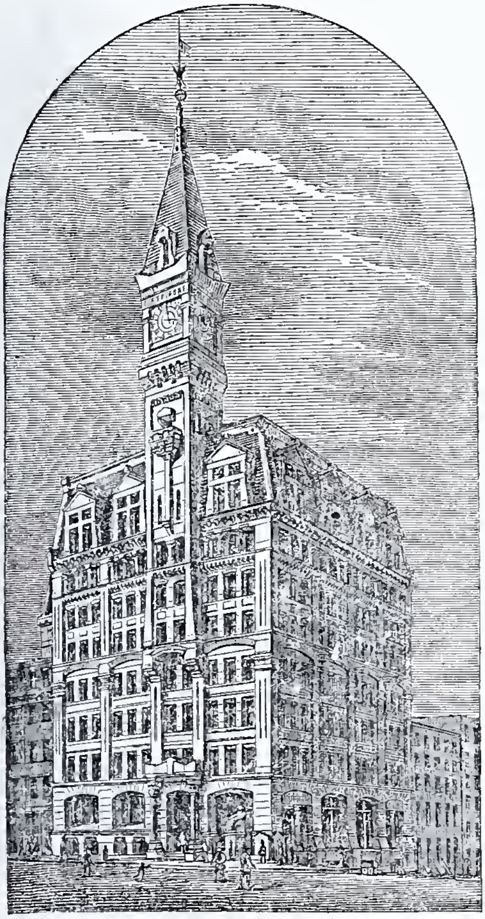

The new Tribune Building, now in course of erection, occupies the historic site of THE TRIBUNE, on the corner of Spruce and Nassau-sts., one of the most important central points in the City of New-York and the most eligible location on Manhattan Island for a great newspaper office. The new Tribune Building will be the largest newspaper office in the world, and will contain more than four times the space of any other printing-house in the city. When complete it will front 91 feet on Printing-House-square, 100 feet on Spruce-st., and will extend through to Frankfort-st., a clear depth of 168 feet, and with a front of 29 feet on the street last named. Only a portion of the building, that fronting on Printing-House-square, 91 feet, and on Spruce-st., 52 feet, is now erecting, and this will be so far completed as to allow its occupation by THE TRIBUNE before the remaining section is begun. In this front building, as well as the completed structure, will be a cellar, basement, and nine stories, excluding the attic. On Printing-House-square, above huge foundations, laid in with granite bond-plates and cap-stones, a majestic tower will rise nearly 260 feet. The main entrance will be in the front of this tower, which, from the starting point of the foundation, 25 feet below the sidewalk level, to the top of the finial, will measure 285 feet. The hights of the stories are as follows: First story, corner office (to be used as THE TRIBUNE counting-room), 21 feet, with a rise of 18 inches above the curb at the intersection of Nassau and Spruce-sts.; first story, office north of main entrance, floor 8 feet 6 inches above the curb 14 feet high ; second, 12 feet 6 inches ; third, 12 feet; fourth, 11 feet 6 inches ; fifth, 11 feet ; sixth, 10 feet 9 inches ; seventh, 10 feet 6 inches ; eighth (composing-room), 20 feet, and ninth, 10 feet. From the curbstone to the eaves at the top of the outside wall of the west (Spruce-st.) front will measure 106 feet ; the roof is a Mansard, with peaked top, and rises about 40 feet from the eaves to the top of the peak, making the hight from curb to peak on the main front 146 feet. On the Spruce-st. side the decline of the curb is about five feet, so that the hight at the south-eastern corner will be over 150 feet. Sixty feet from the curb, the tower is corbeled out, projecting from the face of the wall 2 feet 6 inches, and this projection is continued to the top of the masonry of the tower, 196 feet above the curb. At the hight of 150 feet a little balcony appears on the front of the tower, and from this the national flag will be displayed on suitable occasions. One hundred and sixty-seven feet from the ground will be an immense clock with four dials each 12 feet in diameter, which will be illuminated at night. The figures on the dials are to be cut in granite and gilded. The inside facing will be of plate glass, through which the light from within will display the figures. The tower will be four-sided, and at the point where it rises above the roof will be 17 feet square. It will be of solid masonry to the hight of 196 feet from the curb, and above that point will be of iron covered with slate, rising 64 feet higher. In the lower part of this spire will be four arched openings to be reached by a staircase, and from these far-reaching views of the city, the bay, and all the surrounding country about may be obtained.

The construction of the building is of the most substantial and enduring kind, such as shall insure its standing for ages a fit memorial of the great Founder of THE TRIBUNE, and a perpetual testimony to the success of the great journal into which he breathed the breath of life. The foundation walls rest upon a concrete bed 10 feet wide and 18 inches thick, composed of Portland cement, sand, gravel, and stone, a composition novel in this city, and hardening very quickly into extreme solidity. Upon this concrete is a continued course of granite slabs 18 inches thick, and varying from 10 feet to 6 feet 6 inches in width. Under the piers of the front and the tower walls are other granite slabs over these, some of which weigh more than 10 tons. Upon these granite courses the brick work rests. The piers of the front are of so-called Croton pavers' brick, laid in Portland cement, with granite bond-stones 10 inches thick. The inner walls are of Haverstraw brick, laid in Rosendale cement. On the level of the basement floor starts the granite work of the front extending in solid blocks, bond-

ing alternately through the whole depth of the piers to the second story. Baltimore front brick, laid in black mortar, will be the chief material above the second-story level. The trimmings of the first story will be of Quincy granite, and of the others, white granite. Windows, cornices, and towers will also have heavy granite trimmings. The solid character of the structure is shown by the thickness of the walls, which, beginning at the street level in the first story, will be 5 feet 2 inches thick, diminishing gradually to 2 feet 8 inches at the eaves. The north end south tower walls are to be 4 feet thick to the level of the main cornice, then 3 feet 2 inches to the level of the eaves of the tower roof. The main piers, window piers, and jambs are each to have a reveal of 13 inches. The intervening space between the pilasters, of which there are five, or the western and southern fronts respectively, is 16 feet. Geometrical designs in white, black, and red brick will vary the appearance of the exterior, and a row of small granite columns extending around the entire front, on three streets, will make an imposing feature of the seventh story.

The excellence of the interior of the building will fully equal the merits of its exterior. First among its claims to praise is the fact that it is absolutely fire-proof in every part. All floor beams will be of iron, supported only by solid masonry. The floors will be of tile, and the partitions of tile or plaster of Paris. Not a single cast-iron column will be used as a support. The stairways will be of fire-proof material, and will be built in substantial masonry, and the elevators will be thoroughly protected. As the roof is entirely covered with slate, no danger need be looked for from that quarter. The arrangements for light, heat, and ventilation will be unequaled. All the offices, halls, and staircases will be lighted from the outside, and in every room a direct supply of fresh air will be furnished through openings beneath the window-sills. The heating will be by steam. Three elevators will give easy access to every story, and the whole building will be supplied with every device for comfort and beauty. The main entrance, 9 feet wide and 18 feet 6 inches high, is flanked on either hand with massive columns of highly polished granite. Lining and finishings of granite in the vestibule will correspond to the outside, and the ceiling will be vaulted in groined arches with Baltimore brick. On either hand, as the vestibule is entered, will be seen large directories guiding to the numerous offices in the building.

South of the main portal and entirely distinct from it will be the entrance to THE TRIBUNE counting-room. Just within the doorway will be placed a life-size statue of Mr. Greeley of marble or bronze, the material for the work not having been decided. THE TRIBUNE counting-room will be 20 feet in width, and occupy the whole front on Spruce-st. It will be admirably fitted and provided with pneumatic and speaking-tubes, electric annunciators, and other means of communication with the editorial rooms. These will be in the seventh story, and the compositors' room in the eighth, till the entire building is finished, when the editorial rooms will be in the lofty eighth story—which has a hight of 20 feet—on the Park front, and the composing-room, stereotype-room and proof-room will be in the rear of the same story, running from Spruce to Frankfort-st. With the exceptions of these portions of the building and the basement room looking on Spruce-st., which will be also used by THE TRIBUNE, the entire building, from the ample bankers' office in the basement to the eighth story, will be for rent for professional tenants. No manufacturing business of any kind will be admitted to the front building. In the basement and first story of this building there will be handsome bankers' offices, 45x27 feet, north of the main entrance. The rest of the available space on the first story will be taken up by the counting-room. On each of the floors above, to the eigth, there will be seven eligible apartments, provided with every convenience.

When the front building is finished, THE TRIBUNE will remove into it from its present quarters, which, with the other structures on the estate, will be immediately demolished, and the building of the rest of the edifice will be pushed forward rapidly. Richard M. Hunt of this city is the architect. The mason work is done by Peter T. O'Brien of this city, and the cut-stone work by James G. Batterson of Hartford.

THE NEW-YORK TRIBUNE is beyond a doubt the most influential, fearless, and independent paper in the country. It never enters the field of startling sensations, but gives the news and discusses all public subjects in a spirit of candor and honesty.—[Great Barrington (Mass.) Courier (Administration Republican.)

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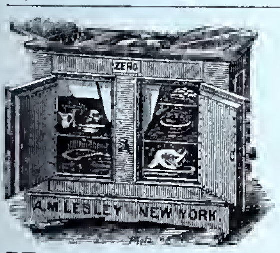

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